AMATEUR WORK

EXAMPLES OF WORK DONE BY AN AMATEUR PHOTOGRAPHER, REPRODUCED FROM THE ORIGINAL BY PHOTO-MECHANICAL PROCESS.

"THE LANE THROUGH THE ROOKERY."

Date: November 25th. Time of Day: 1.35 p.m. Lens: Dallmeyer's Wide-angle Landscape, Small Stop. Plate: Britt. Ordinary. Exposure: 28 seconds.

PORTRAIT,
TAKEN IN ORDINARY
ROOM.

Time of Day : 2.35. Studio Camera, Ross' R. S. Lens. Plate : Wratten's Inst. Exposure : 16 seconds.

TAKEN WITH A GUINEA SET.

Date : March 20th. Time : 4.45. Plate : Ilford Ordinary. Exposure : 11 seconds.

AMATEUR WORK,

ILLUSTRATED.

EDITED BY THE AUTHOR OF

"EVERY MAN HIS OWN MECHANIC."

WITH SUPPLEMENTS,

Containing Designs and Working Drawings to Scale,
For Various Pieces of Work, Useful and Ornamental,

AND

SEVERAL HUNDRED DIAGRAMS AND ENGRAVINGS ON WOOD.

VOLUME V.

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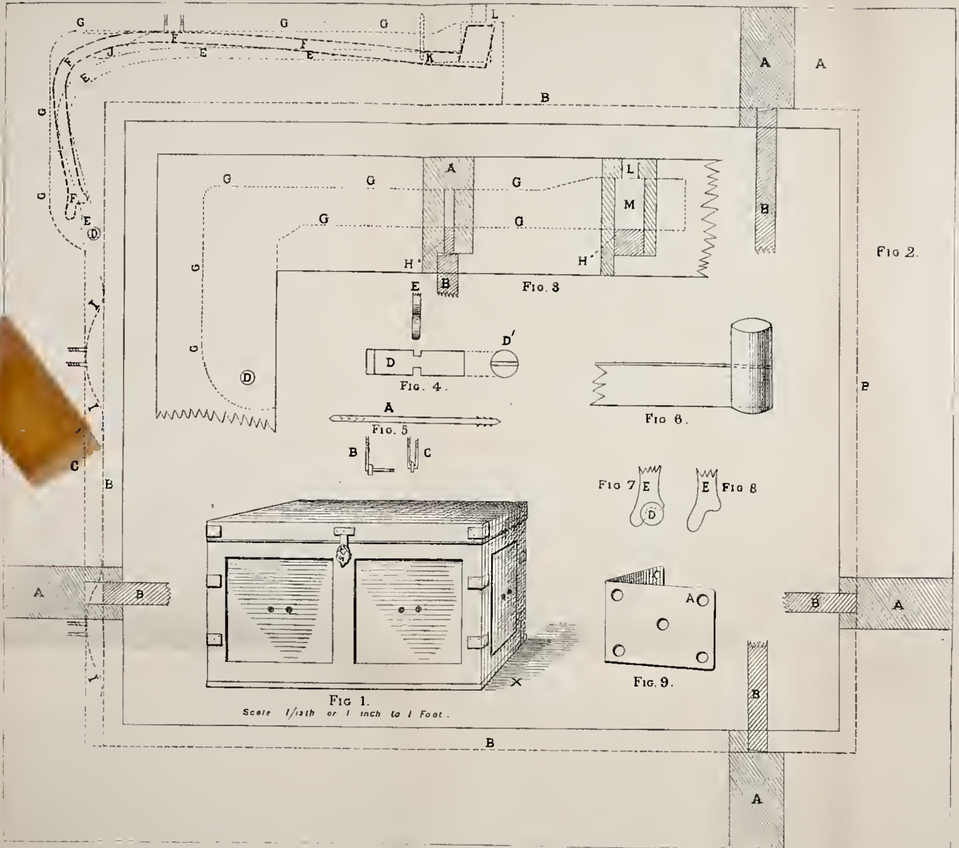


THE LOCKED AND CORDED BOX TRICK. By DAVID B. ADAMSON.

Figs. 2 and 3 are half full size. Figs. 4, 5, 6, 7, and 8, full size.

AMATEUR WORK, ILLUSTRATED.

GLASS-BLOWING FOR AMATEURS.

By ALFRED W. SOWARD.

I.—INTRODUCTION—MATERIALS—TOOLS—USE OF THE BLOW-PIPE.

THE art of glass-blowing is of extreme antiquity. When it was invented we do not know, but it was certainly practised by the Egyptians more than four thousand years ago, as is evidenced by the paintings in the tombs of Beni-Hassan, near Thebes.* Of the origin of the art of glass-making we know even less. Pliny, the industrious Roman historian of science, has given us an account, but it must be accepted as probably a mere fable. He tells us that a party of Phœnician merchants returning by sea from Egypt with a cargo of natron (soda), were driven by stress of weather into the mouth of the river Belus, which flows from Mount Carmel in Galilee. Landing on the river's sandy bank, the sailors lit their watch fires, and supported their cooking vessels thereover by lumps of natron from their cargo. The fine sand of the river's bank and the lumps of natron were fused together—so runs the legend—and glass was first formed. "Who, when he saw the first sand or ashes by a casual intenseness of heat, melted into a metalline form, rugged with excrescences, and clouded with impurities, would have imagined that in this shapeless lump lay concealed so many conveniences of life as would in time constitute a great part of the happiness of the world?"

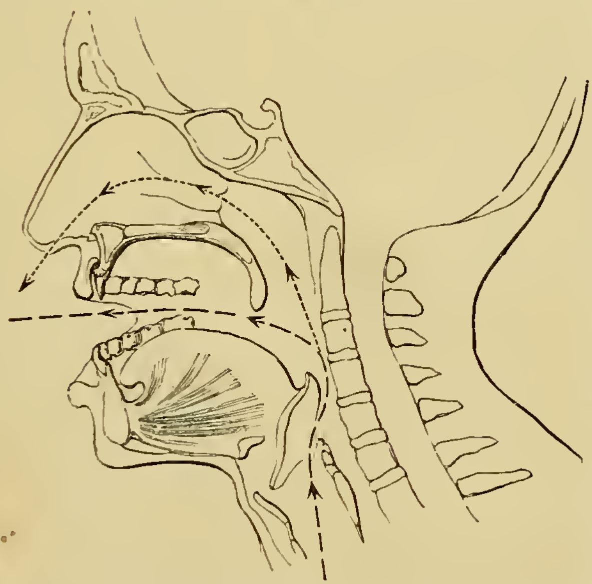


FIG. 4.—DIAGRAM SHOWING AIR PASSAGES OF HEAD AND THROAT.

Whether we accept the account of Pliny as fact or fable, we can hardly doubt that glass was first formed in some such casual way. It would take too long, and would moreover be foreign to the purpose of these articles, to sketch, even in broad outline, the history of the development of the art from this its first mythic origin to the position it occupies to-day. The tale has been told already by many writers, and to other pages the curious enquirer must be referred.

The chemical nature of glass has already been explained in these columns ("Etching on Glass," Vol. III., p. 27); and it will be remembered that this substance was there described as being essentially a mixture of silicates. The three varieties of glass most usually met with in the laboratory are: Common Soft English Crown Glass, Soft Flint Glass, and Bohemian Glass, so difficult to fuse. The first is a double silicate of soda and lime, sometimes containing also silicate of potash; the second is a double silicate of potash and lead; and the third a double silicate of potash and lime. The properties of the glass are due, in great part, to the chemical nature of the silicates entering into its composition; one conferring hardness, another softness, another lustre, and so forth.

The tools required by the glass-blower are few and simple. They consist of a suitable source of heat, a blow-pipe, a few files and tongs, and one or two other articles which will be presently mentioned. Of these the most important are the two first-named. The source of heat must vary with the nature of the work to be performed. For some operations a candle or gas flame will suffice; for others the flame of a pro-

* Consult Sir Gardner Wilkinson on "The Manners and Customs of the Ancient Egyptians."

perly constructed glass-blower's lamp, or of a Herapath gas blow-pipe will be required.

The simplest source of heat, but the one having the smallest sphere of usefulness, is the plain candle or gas flame unaided by a blast of air: it suffices for the mere bending of glass tube and rod, but is of little value beyond. By the aid of a mouth blow-pipe, the power of the flame may be greatly enhanced.

This instrument consists essentially of a tube with a right-angled bend near one end, and having the long arm of the bent tube terminated by a mouth-piece, and the short arm by a nozzle of small bore. Its object is to enable a blast of air from the mouth of the operator to be directed upon a flame, whereby the character of the flame is entirely changed. Before the blast is applied, the flame is vertical, broad, and conical at the upper end, its shape and position being determined solely by the uprising currents of heated air generated by the combustion of the fuel; its colour is yellowish-white, due to the imperfect combustion of the carbonaceous materials forming the gas, or, in the case of a candle flame, the vapour rising from the fat. But when a jet of air from a blow-pipe is caused to impinge upon a flame, the character of the latter is entirely changed. The flame is no longer vertical, but assumes a position more or less horizontal, as determined by the direction of the blast. The broad, obtuse, conical flame of yellowish-white, gives place to an acutely pointed, scarcely visible, jet of intensely heated blue flame.

The blow-pipe is made in many different forms, but the instrument most commonly in use is that which bears the name of Black (although not designed by him). It is represented in Fig. 1, and consists of a japanned tin, or brass conical tube, closed at the large end, and having a mouthpiece at the small end. Near the closed end a small cylindrical tube juts out at right angles with the axis of the big tube, and is terminated by a conical jet, which, to ensure good results, should be bored as shown in Fig. 2, and not, as it usually is, as shown in Fig. 3.

To use the blow-pipe effectively, the operator must be able to maintain a perfectly continuous blast of air for any desired time, and to do this is quite an art in itself. On no account should anyone use a blow-pipe, except very occasionally, until this art has been acquired, for so doing may result in irretrievable injury to the lungs; but the art once acquired, the blast may be maintained for half an hour at a time without risk of injury, and with no more inconvenience than such as is caused by the tiring of the muscles of the face and lips.

Let us now consider what this necessary art consists in, and how it can be acquired. In doing which our labour will be lightened if we bear in mind the structure of the air passages of the mouth, nose, and throat; and a glance at Fig. 4 will assist us in this. We see that the tube—the windpipe or trachea—leading from the great air cavities of the lungs rises until it reaches an arched opening leading sideways into the mouth. Passing through this archway, the air current flows on between the tongue and the palate, until it issues at the mouth; but it must be noticed that the air current is under no compulsion to find egress to the outer air by way of the mouth, for there is a path open to it through the nose, and if the mouth is closed (as on considerations of health it should be when not speaking) this is the only outlet.

There is probably no one in good health who has the slightest difficulty in breathing through the nose when the lips are closed, and, conversely, in breathing through the mouth with the nasal opening closed;* but the next operation is more difficult, probably because in ordinary life no one has occasion to perform

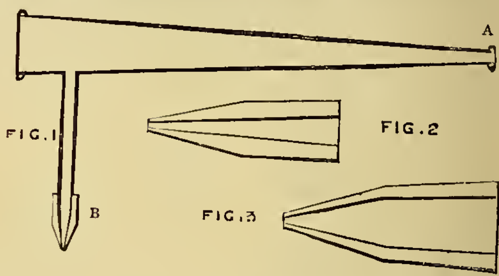


FIG. 1.—BLACK'S BLOW-PIPE (SECTION).—A, Mouthpiece; B, Nozzle. FIG. 2.—GOOD SHAPE OF NOZZLE (SECTION). FIG. 3.—BAD SHAPE OF NOZZLE (SECTION).

it. It is to close the lips firmly, to blow air from the lungs into the mouth until the cheeks are tightly distended, and then, by raising the tongue, to close the passage leading to the lungs, after which, the passage being still closed, to carry on breathing through the nose. At first the sensation is very curious, and the muscles of the tongue and cheek soon tire, but practice speedily overcomes this.

When the learner has advanced thus far, and is able to breathe in comfort through his nose with cheeks distended, he may advance to the next step, which is to tap the store of compressed air in the cheeks—compressed because the muscles are under tension—and to turn the blast to a useful purpose.

To do this, let a blow-pipe *having a very fine nozzle*—this is important—be introduced between the lips. The cheeks will—or rather should—gradually collapse, a gentle and constant blast of air issuing from the nozzle of the blow-pipe, until the mouth is

* Some few people who are unable themselves to do this, say that the nasal opening cannot be opened and closed at will, but it certainly can.

nearly empty. In all probability at the first attempt the tongue will fall away from its opening, and the cheeks will collapse *at once*, the air contained in the mouth rushing backwards and upwards to the nose. This is due to the fact that sufficient attention is not at first paid to the relative pressures on the two surfaces of the tongue. It must be remembered that the tongue here acts very much as a hinged valve ; when the pressure is greater inside the mouth than in the throat, the valve will press against the sides of the arched opening, and, being flexible, will adapt itself to their form, and completely close the opening ; and it will be held there by the pressure of the air in the mouth, its muscles not coming into play to any considerable degree. But when the pressure in the throat is greater than the pressure in the mouth, the valve will fall away, and air will rush into the mouth until the pressures are equalized—that is, until the tension of the cheeks balances the propulsive force of the lungs. The valve being then closed by a muscular action, and the pressure in the throat relieved by permitting the air to pass through the nose, the tongue is held in place solely by air pressure from within the mouth. Bearing this in mind, it is evident that if the pressure in the throat at the moment the blow-pipe is inserted between the lips at all approaches that in the mouth, the immediate effect of inserting the blow-pipe, and consequently diminishing the pressure in the mouth, is to cause the valve to be forciby thrust away from its place, and to allow the imprisoned air to mix with that in the throat, the effect of which disturbance is generally that mouth and lungs empty themselves by the nose.

Assuming that we have mastered the subject so far, let us proceed to the last and most difficult part of the whole operation—that is, the keeping up of a constant blast. We have learnt to breathe quietly and comfortably with distended cheeks, and we have learnt to empty our mouth through the lips without moving the tongue from its raised position. We have next to learn how, when the mouth has been nearly emptied, to replenish the supply of air contained therein, so that the mouth may never become quite empty. To do this we have only to remember when the cheeks have sunk nearly to their ordinary position, to send a blast of air from the lungs against the raised tongue, the outlet by way of the nose being at the same time closed. The increased pressure in the throat forces the tongue away from its position, the mouth fills with air, the cheeks are distended, and by a muscular effort the tongue is replaced in its position as a valve ; the nasal outlet is reopened, and the pressure in the throat released by the expulsion of air through the reopened nasal passage.

By a regular repetition of all these actions, which are soon performed unconsciously, a perfectly uniform and continuous blast of air may, without injury to the lungs, and without noticeable effort or exhaustion, be maintained even for a lengthened period.

Some writers have contended that in using the blow-pipe the air must never be supplied by the lungs, but must (presumably) be sucked into the mouth through the nose, during inspiration. These writers can never have used a blow-pipe, or, if they have, have done so, so inattentively, that they have failed to notice how they use it ; for the method they recommend is surely an impossible one. They state that air from the lungs is of no value to urge a blow-pipe flame with, as such air is laden with carbonic acid. But the air expelled from the lungs contains but 4 per cent. of carbonic acid, and is, therefore, as a supporter of combustion, not vastly inferior to ordinary air.

A few words before quitting this part of our subject, upon the function of the mouth in blowing :—It is primarily to maintain the blast constant. An intermittent blast could be produced by the lungs alone, but during the act of inspiration, the blast would cease, and it is to avoid this difficulty that the mouth is primarily used. The mouth is to the lungs what the sudsidiary air chamber of a pair of double bellows is to the bellows themselves. The power comes from the bellows, and is stored up temporarily in the air chamber, and so the power comes from the lungs, but is stored up temporarily in the mouth. Faraday compares the mouth to the going fusee of a chronometer, which, when the machine is wound up for the renewal of motive power, causes the works to advance during the interval in which the direct action of the spring is taken off by the hand which holds the key. The mouth may also be compared to a fly-wheel, which carries machinery over dead centres where it would otherwise stop.

In addition to this primary action of the mouth, there is a secondary regulating or modifying action. The muscles of the cheeks are very powerful, and by regulating the force of their muscular contraction the force of the blast of air may be varied within very wide limits.

Having now fully considered the method of producing and maintaining a uniform blast of air, we have to consider its application in the art of glass-blowing, but before doing so, we shall turn aside in the next paper to examine the various sources of heat useful for our purpose, and in so doing shall necessarily enquire into the methods of producing more powerful blasts of air than the lungs and mouth are capable of, even if the mouth blow-pipe were used by one whose skill should rival that of the celebrated Plattner, unrivalled in blowing.

(To be continued.)

MODEL YACHTS:

HOW TO DESIGN AND BUILD THEM.

By ARTHUR C. HIDE.

I.—DESIGNING—SHEER PLAN—HALF-BREADTH PLAN —BODY PLAN—CENTRES OF GRAVITY AND DISPLACEMENT.

BY way of preface to those readers of AMATEUR WORK who "can't think what people can see in such childish amusement," I will just say, what, no doubt, they have seen pasted about in a good many streets, "*Try it;*" and if their first model is one that they can pit against existing ones with success, and if they can make her go where they will the first time she is put into the water, I will say they are right, it *is* a childish amusement; but until that is done, I must still hold on to my opinion, that model building and sailing is as scientific and amusing a hobby, combining both in and out-door pleasure, as can be found. "So, there," as the tender sex have it. And now to work. I shall take it for granted that you know how to make a mechanical drawing, since it has been explained in this magazine, for before you can attempt anything in models you must draw them out.

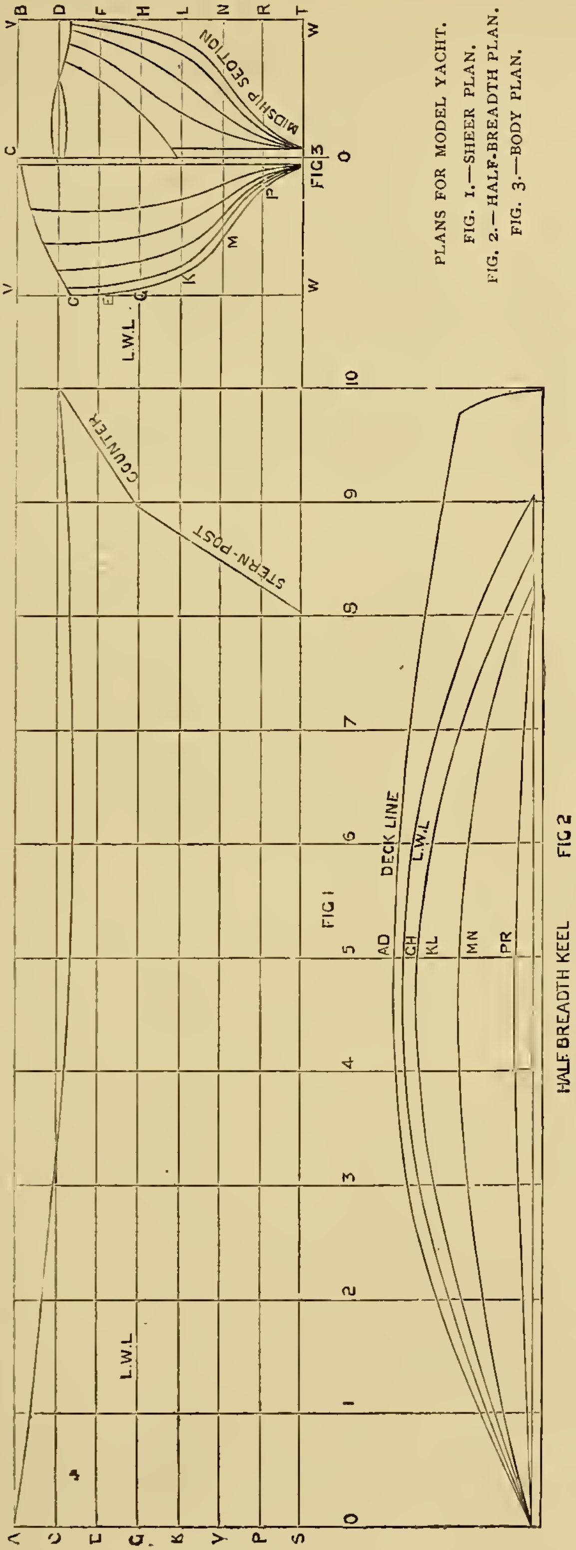
There are three plans of a model to be drawn out. Firstly, the sheer plan; this represents a view of the boat when looking at it directly from the side, as shown in Fig. 1. Then there is the half-breadth plan, which is a view of the half of the model (Fig. 2), looking at it from underneath. And, thirdly, comes the body plan (Fig. 3), which is the view from the front on the left half of the plan, and the view from behind the model on the right half.

We must begin with the sheer plan. The shape of this depends in a great measure upon taste, but for the first model it would be better to keep to the illustration shown here. Having selected a sheet of paper, to take the full size of the model if possible, (if not you will have to draw to scale), and glued or pinned it on the board, draw at about 6 inches from the top a line right across the paper, and draw it pretty heavily, for you must work all other lines from this one. Mark this on each end L. W. L., which means load water line, and is to represent the surface of the water, when the model, with all her rigging, and quite complete in fact, is stationary in the water. But, before going any further, you must determine upon the dimensions your yacht is to be. A very good size is 2 feet 6 inches over all—that is to say, from stem to end of counter, and, as many model yacht clubs adhere to this size, I should, I think, follow their example. The beam, or breadth, should be about one-fourth of the length. Fancy dictates here in a very great measure, as it does in a great many things in model yacht building. Some like a broad beam and some a narrow beam; but *experientia docet* applies here very well, and as most probably you are without *experientia*, keep to the "4 to 1" dimensions. I should therefore make her 7 inch beam, so as to keep to an even figure. Now for the depth below the water line, take about one-seventh of the length, that will make it 4 inches deep. This is merely to the bottom of the wooden part of your model, and does not include the lead keel, which will come on afterwards. For the height out of water you must study circumstances a little. You see, to make a boat look pretty, there is always a certain amount of what is called "sheer" given her—that is to say, a certain curve beginning high at the bow, falling towards the centre, and then rising again at the stern. Therefore you must have a fixed dimension for your height above water at the stem and draw in your sheer according to fancy afterwards. Then again too high a stem looks bad, and moreover is apt to hold the wind and retard the boat's speed, whereas too low a stem does not afford sufficient support to her if she has a press of canvas on. I think about 3 inches for a 2 feet 6 inches model is very fair, and the sheer you must determine yourself, or take it from the diagram here. Now you may begin drawing out in earnest. Parallel to your load water line draw 4 lines below each other, each 1 inch apart from the other. The lower line will then represent the bottom of the keel, 4 inches below the water line. Now draw three lines above the load water line, also 1 inch apart. The top line would then represent the deck line if the deck were without sheer, but now simply represents the 3 inches at the bow. These lines will represent so many planes cutting the boat parallel to the surface of the water.

The next thing to draw in is the stem, or bow; keep this about a couple of inches from the edge of your paper, and never mind, for the present, the curve at the foot. Simply draw a straight line vertical to the load water line. Now, at distances of 3 inches, draw lines parallel to the bow—that is, vertical to the load water line, to the extent of 30 inches, which will give you eleven lines, and ten spaces of 3 inches each, which will be the exact length of your model. The counter, or overhanging part, should be about 3 inches, so draw that in to your own fancy, and consult your fancy also on the "rake," or slope of the stern-post, which should have more or less rake to allow the rudder to swing easily, of which more hereafter.

The body plan is drawn on the extended horizontal lines of the sheer plan, and the half-breadth plan on the extended vertical lines of the same.

Now, there is one part of a ship, looking at her



PLANS FOR MODEL YACHT.
FIG. 1.—SHEER PLAN.
FIG. 2.—HALF-BREADTH PLAN.
FIG. 3.—BODY PLAN.

endways, which is larger than any other part, and past which no other part of the vessel is visible: this is termed the "midship section," and is represented by the outside lines in the body plan. We intend making the midship section on the line 5, which will be rather abaft the centre of the load water line. Some builders prefer a long "entrance," which necessitates having the midship section far back; while others like a short "entrance" and a long "run," which means having the midship section well forward, so that the bow lines converge at a greater angle than the stern lines. Now draw a centre line, X Y, on the half-breadth plan, and on 5 mark off from X Y $3\frac{1}{2}$ inches, which is the half-breadth of your vessel. Above X Y draw a line parallel to it, and at a distance of $\frac{1}{4}$ inch, to represent the half-breadth of the keel, and then with a thin spline or batten draw in the deck line on the half-breadth plan to pass through the dot on 5, and fall nicely into the *keel* line in front, and rounded at the stern for the counter. You had, for the present, better keep as near as possible to the diagram shown here; but when you get a little more accustomed to drawing in these curves you will be able to judge for yourself if a line is what, in shipbuilding parlance, they call "pretty." Leave the half-breadth plan for a little while, and on the body plan draw a vertical centre line, O O, and on each side of it draw lines at $\frac{1}{4}$ in. distant, and parallel to it, to represent the keel. One part of this body plan, you must remember, is the forepart of the vessel, and the other half the after part. Now on the load water line, still in the body plan, on each side of the centre line mark off $3\frac{1}{2}$ inches, which is half the beam, and, starting from this point, draw in by hand a curve somewhat similar to the one in the diagram, and see that there are no "lumps" in it, and that it falls nicely into the straight line of the keel at the bottom. Having rubbed this out and put it in again several times till satisfactory, rub it *nearly* out once more, and put in definitely with curves, so that you have a *definite* spot where the curve crosses each horizontal section. Do this on each side of the centre line O O. Go back again to the half-breadth plan, and with your dividers mark off on 5 from X Y the places where the midship section, which you have just drawn in, cuts each of the horizontal sections—that is to say, the distances from O O to C, to E, to G, to K, to M, and to P. Through these points, or rather through the point G firstly (which is the load water line), draw a curve to the bow, and to line 9, taking care to make it fall nicely into the straight of the stem and stern-posts, the thicknesses of

which are represented by the line above X Y. You must be particularly careful to draw this curve in nicely since all the other lines are worked from it, and let me impress on you that india-rubber is, in the present state of the market, a cheap article, therefore you need not be afraid of wasting it by rubbing the line out again, if not to your fancy. There must be no "lumps" in the curve, and no sudden rise or fall; it must all be gradual. To find out if the line is "fair," you need only look along it, with your eye nearly on a level with the paper, and any little inaccuracies will at once become perceptible. Having "faired" this to your satisfaction, mark off from O O (in the body plan), on the line G (the load water line), the respective distances from X Y (in the half-breadth plan), to the points where the curve, which you have just drawn in, cuts the lines 4, 3, 2, 1. Treat the after part of the load water line in the same manner, but mark it off on the right-hand side of the body plan.

Now draw in the other curves in the half-breadth plan through the points already marked on 5, trying to keep them as little hollow as possible. These lines you must simply guess at to begin with, but after a little practice your eye will tell you very nearly where to draw them in. After this is done, mark off from O O on C, E, G, K, M, and P, the distances from X, Y, along 4, to where the curves C, E, G, K, M, and P, respectively cross 4. Through the points thus obtained draw a curve, and if the curve thus drawn falls in nicely, without lumps or kinks, your lines in the half-breadth plan will be pretty nearly right. Treat the lines 3, 2, 1, on to the left-hand side of the body plan, and 6, 7, 8, 9, on to the right-hand side, in the same way, and if each curve comes in nicely your lines will be right; if they do not fall in well, you will have to alter the "water lines," as they are termed, in the half-breadth plan, until the body lines can be faired easily.

It will, I am sure, entail a good deal of rubbing out and putting in again, before your lines will come right, but do not be afraid of that, since it makes your work much easier when you come to the wood-working part of the business, and do not say to yourself, "Oh! bother it, I can't get that right on the drawing, but it will come in all square in the wood." It is a fallacy, I can assure you; you would never have been more mistaken than when you said that. If your drawing is not correct, your wood-work cannot be correct, and therefore you will be guessing at things all through the job, instead of having everything down on paper in a respectable manner. So put that notion out of your head, and say it *must* come right in the drawing, and when it *is* right you will be a great deal more satisfied with yourself, I am sure.

You have not yet, by the bye, drawn in on the body plan, the sheer, therefore measure off the heights from the load water line to the sheer in the sheer plan on the various lines, 1, 2, 3, 4, 5, etc., and mark them off on their corresponding lines in the body plan, and the distances from O O to 1, 2, 3, etc.; you will take, of course, from X Y, in the half-breadth plan, to the deck line along 1, 2, 3, etc., there. Having joined the points thus obtained with a nice curve, I think your drawing is finished. The keel you can only put in afterwards, when you know the weight of lead your boat will carry, which will be more or less, according as you have made your lines "fuller" or "finer."

In the next paper, then, I shall begin with the building of the model; but before we come to that, a few words on the shape of models would not be out of place. Models must be considered as racing yachts, and, therefore, unlike merchant vessels, carrying power, or rather "cargo space," is no object. The great thing in models is to get your lines as nice as possible, and, to my own idea, the less hollow a line the better it is. Then again, as I said before, some like the midship section forward of the half-length of the boat, while others, myself included, prefer it abaft.

It appears to me that, considering a vessel is nothing more or less than a wedge driven through the water, the smaller angle that wedge has the easier it will separate the particles of water with a given driving power; and then, again, as water will close up again more easily than it will be separated, so the quicker the lines in the stern converge, the better, to a certain extent. In both these, as in every other case, excess is not meant, and you must, therefore, not make too long an "entrance" or too short a "run."

With regard to the proportion of beam to length, there are one or two points to be considered before deciding this matter. Firstly, beam gives a vessel greater carrying power, and, to a certain extent, greater "stability"—(by stability is meant the power a vessel has of resisting any force which tends to press it over on its side, when in the water, of course) —or, I should rather say, greater "stiffness." A broad and shallow vessel is "stiffer" up to a *certain* angle of inclination than a narrow and deep boat, but press both over to *that* angle and you will find that past that point the broad vessel will perhaps capsize easily, whereas it will be impossible to capsize the narrow but deep one, since she will always right herself again. Now this is easily explained when you know that there are two very important points, or "centres," in a ship: the one known as the "centre of displacement," which is in reality the centre of gravity of the mass of water which the ship "displaces," or takes the place of, when she is put into the water; and the other the "centre of gravity" of the

ship itself. When a ship heels over you can readily see that her centre of displacement will shift, because the shape of the water she displaces alters as her own shape differs under water, according to the various angles of inclination. Therefore in a shallow ship, where the centres of gravity and displacement are close together, the centre of displacement has to shift very little to cause the vessel to capsize; but in a deep boat it has to shift a great deal, since the two centres are further apart. So, then, in a model you must combine the qualities of a broad vessel and a deep one; but take care not to get her *too* broad, because the lines will not be fine enough in that case, nor must she be *too deep*, since the more surface a boat has in the water the greater is the resistance caused by the friction of the water on her sides to her headway.

I am afraid space will not permit me to say more about designing, but practice will assist you more than anything else, and if you can reason a few points out for yourself, so much the better. About the centres I shall have more to say further on, when we come to building.

(*To be continued.*)

THE REFLECTING TELESCOPE:

ITS CONSTRUCTION AND MANUFACTURE.

By EDWARD A. FRANCIS.

I.—INTRODUCTION—THEORY—VARIOUS FORMS OF THE REFLECTING TELESCOPE.

IT is not my purpose here to dilate upon the pleasures attached to the study of astronomy, but rather to remind those who find the purchase of a large telescope an object beyond their attainment, that it is possible for them to imitate William (afterwards Sir William) Herschel, who, when in a similar predicament, fashioned with his own hands that instrument which he could not purchase. If these papers should induce any of my readers to follow such a praiseworthy example, and prosecute that most interesting of studies, the science of astronomy, my aim will be fully accomplished. For further encouragement I will mention that several of the eminent speculum makers of to-day originally worked not for profit, but for pleasure.

There are two kinds of telescopes, refractors and reflectors. In the former the light rays are refracted to the eye by transmission through one or more lenses; in the latter the same end is obtained by reflection.

As to the comparative qualities of the two constructions there is much argument between astronomers, and as each construction possesses peculiar properties when compared with the other, a decision is not likely to be arrived at; but the reflector is less costly, and it is a significant fact that opticians of reputation have given the same test objects for equal apertures of the two forms.

The working of a perfect object-glass for a refracting telescope of large aperture, will most probably always remain an intricate branch of practical optics; and the manufacture of glass of the limpidity requisite for its construction is the acme of the glass-maker's craft. These facts place the refractor beyond the reach of the average amateur, the price of two 9 inch discs of optical glass being from £25 to £30, while the completed lens, if worked by an excellent maker, would cost, unmounted, at least £150 and probably £200. A perfect speculum of similar diameter could be purchased for one-tenth of the latter sum.

The laws of refraction are somewhat abstruse when compared with those of reflection. For this reason, and because one surface only requires to be optically worked, a speculum is easier of construction than an achromatic lens: but though the process of construction is less intricate, it is more delicate, for a deviation from the required curve which would be imperceptible in the performance of a good object-glass on a celestial body, would mar the definition of the same object by a speculum.

For ordinary terrestrial purposes refracting telescopes of small aperture are commonly employed; but astronomical observations require larger apertures, and these are furnished by the more perfect refractors and by reflecting telescopes which have their specula formed of speculum metal, or of glass coated with polished silver. It is intended to describe in these papers the methods of constructing such reflecting telescopes. Before I proceed to do so, I must beg of those of my readers who would follow with me this interesting subject, to thoroughly master the theory explained in this first paper. There are many points in the working which could not be explained by writing, but which the amateur will readily understand when he knows the reason why any peculiar curve is used for the speculum of a telescope. He should also bear in mind that in the polishing of specula the workman deals not with inches, but with thousandths of inches; that a variation of a thousandth of an inch from the proper curve will render an otherwise perfect speculum useless, and that the freedom from error and excellence of finish, which is generally indicative of the work of a master-hand, is but the result of a precise attention to every detail of workmanship.

Theory.—An object is said to be visible when the

rays of light emanating or reflected from it, strike the retina of the eye and cause an impression to be conveyed to the brain.

The rays of light from a luminous object diverge in every direction, expanding as their distance from that object increases; and since the intensity of a ray of light varies inversely in proportion to the area which it illuminates, a distance may be reached where the intensity of the rays will be so weakened by expansion, as to produce no perceptible effect on the retina: the object will then be invisible. It will be seen by reference to Fig. 1 that this invisibility is caused by the limited aperture of the eye. Let A be a point with rays of light *a*, *b*, *c*, etc., radiating from it. An eye placed at the position B, will receive a limited number of those rays, represented by the lines *c*, *d*, and *e*; when we will suppose A to be just visible. Now remove the eye to C, a greater distance from A, and, because the rays of light have expanded, a lesser quantity will enter the eye, and the last-named point will be no longer visible. Obviously, if the rays which entered the eye at B could be caused to enter it at C, the source of light would again be seen.

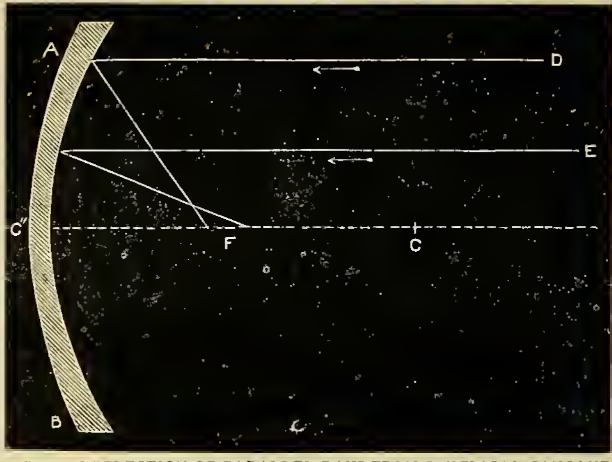


FIG. 3.—REFLECTION OF PARALLEL RAYS FROM SPHERICAL CONCAVE REFLECTOR.

A concave spherical reflector of a diameter sufficient to reflect the rays *c*, *d*, *e*, to a focus at C, as shown in Fig. 2, will form an image of A at C; and if the eye, provided with a lens to render the concentrated rays fit for ordinary vision, be placed near to C on the line C A, the rays, *c*, *d*, *e*, will enter it through the lens, and the point A will be rendered visible. It is evident that a luminous object not so distant as to be invisible, will appear brighter and consequently nearer, by the use of a similar contrivance; and also, that the brightness of the focal image, depending on the number of rays of light reflected, will vary with the area of the reflecting surface.

FIG. 1.—DIAGRAM SHOWING INVISIBILITY OF LUMINOUS OBJECT CAUSED BY DIVERGENCE OF RAYS.

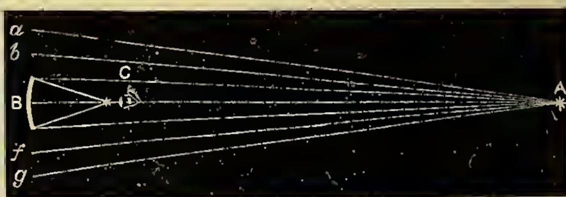


FIG. 2.—OBJECT RENDERED VISIBLE BY CONCENTRATING RAYS IN CONCAVE SPHERICAL REFLECTOR.

The reflector B, with the eye-lens, constitutes a simple reflecting telescope.

The rays of light which cause a star, or other heavenly body to be visible, may be considered to reach the earth parallel to each other; for though when they started on their journey through space they diverged from one point, the distance they

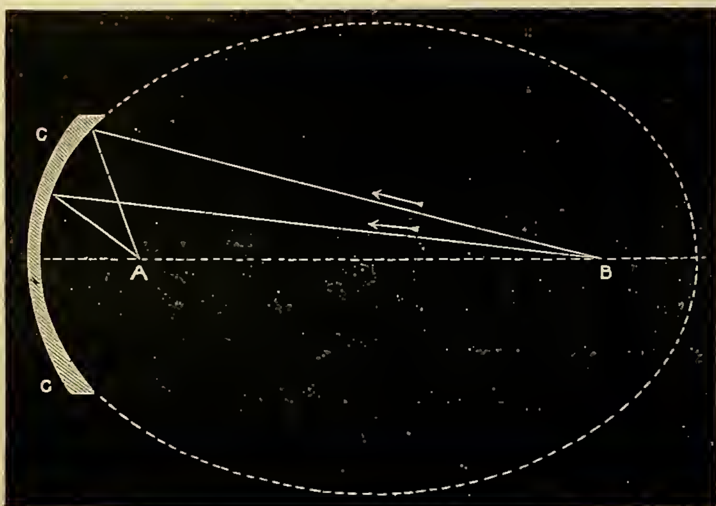


FIG. 4.—RAYS PROPERLY FOCUSSED IN REFLECTOR OF ELLIPTIC SECTION.

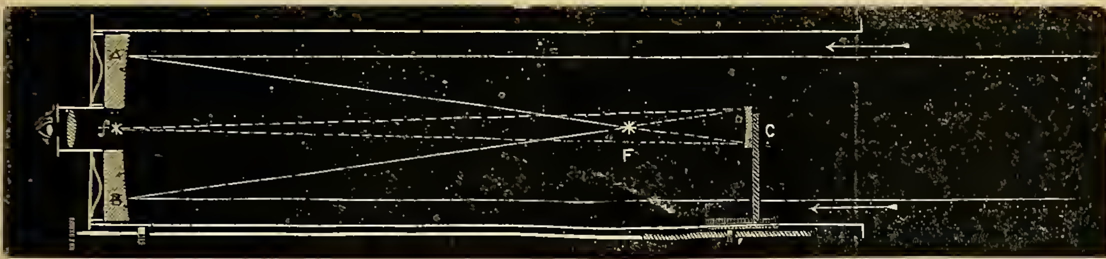


FIG. 5.—DIAGRAM ILLUSTRATING ACTION OF GREGORIAN TELESCOPE.

have travelled is so great, that when received on the earth their divergence is practically nil. This is an important fact, for as will be seen, it decides the curve of any reflector we may make for telescopic purposes. Parallel rays reflected from a spherical concave reflector do not coincide, the rays reflected from the centre forming a focus at a greater distance from the mirror, than those reflected from the margin (see Fig. 3, where A B is a spherical reflector, C″ C its optical axis, and D E incident parallel rays): so that if we consider the mirror divided into a number of concentric rings, each ring will reflect a separate image of the object, and the general focus,

FIG. 6.—DIAGRAM ILLUSTRATING ACTION OF CASSEGRAINIAN TELESCOPE.

instead of presenting one perfect image, will consist of a line of images superposed, each assisting to destroy the distinctness of the others. This effect, or defect, is termed *spherical aberration.*

As the focal length of the reflector, when compared with its aperture, is increased, the amount of curvature employed in the reflecting surface, the spherical aberration, and consequently the amount of correction required to perfect the mirror for the astronomical telescope, are diminished. Correction or alteration from the sphere is, however, in every case necessary; and since we are debarred from using the spherical curve, let us consider what other will be most suitable.

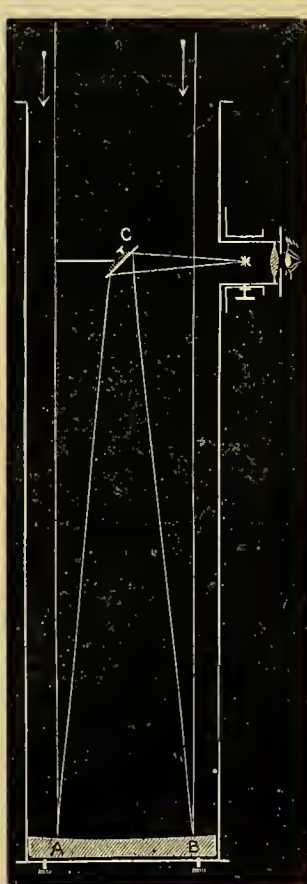


FIG. 7.—DIAGRAM ILLUSTRATING ACTION OF NEWTONIAN TELESCOPE.

FIG. 8.—DIAGRAM ILLUSTRATING ACTION OF HERSCHELIAN TELESCOPE.

It is a peculiar property of the ellipse that lines drawn from its two foci to meet at any point in the curve, make equal angles with a tangent to the curve at that point; or, dismissing geometry, if the section of a reflector be part of an ellipse (see Fig. 4), rays of light from the distant focus B, will be reflected to the near focus A, and will all meet at that point exactly. A reflector of elliptic section will therefore be perfect for the telescope, if the object viewed form the distant focus of the ellipse of which the section of the reflector is a segment. This is a step in the right direction, though we are not yet suited, for celestial objects must be considered at an infinite distance from the mirror. Let us remove the focus B to an infinite distance, so that rays from it will reach the mirror in a parallel state; the curve C C will then be resolved into a parabola, for an ellipse with one of its foci infinitely distant from the other is termed a parabola. If then a parabola be revolved on its principal axis, it will mark out such a concavity, that parallel rays incident on any portion of its surface will be reflected to one point exactly, the aberration of sphericity being annihilated; and a mirror so worked, that a section of its surface will be of a parabolic curve, will form a perfect speculum for astronomical purposes.

I have not attempted to indicate in an illustration the difference between the three curves mentioned, for so minute is that difference, that the finest line the engraver could cut would be far too coarse for the purpose

We have two other points to notice before reviewing the forms of reflecting telescopes. The image of a distant object formed by a concave reflector is inverted. The proof of this statement will be found in any elementary text-book on optics, to which authority the reader is referred; meanwhile he may practically prove it with the aid of a pair of concave (short sight) spectacles, by *reflecting* the light from a lamp or window on to a piece of writing paper, when an inverted image of the object will be seen projected on the paper. In one form of reflecting telescope, the image is re-inverted or erected by a second reflection from a concave surface; but in the other forms it is viewed inverted, unless the process of erection is performed by a suitable arrangement of lenses.

When parallel rays impinge on a concave speculum, they are brought to a focus about midway between the centre of curvature and the reflecting surface, as in Fig. 3, where F is the focus, and C the centre of curvature. As the focal length of the eye-lens is comparatively very short, the distance C″ F, may be termed the focal length of the telescope of which the reflector, A B, would form the principal speculum. Practically—*the focal length of a speculum is one-half of the radius of its curvature.*

The requisite qualities in a good telescope are two—penetrating power and defining power. The first, that which renders faint objects visible, depends on the area and polish of the reflecting surface; the second, the definition of the focal image under various magnifying powers, on the accuracy with which the parabolic figure is imparted to the surface of the mirror.

It will be noticed on reference to Fig. 2, that the observer at C would have to stand in his own light, shutting off a valuable portion of the incident rays. With a telescope of moderate aperture this could not be tolerated, and although a modification in the construction of large telescopes permits direct vision, the necessity for some method of examining the focal image other than directly, led to the invention of several distinct forms of the reflecting telescope, each adapted for that purpose.

Common Forms of Reflecting Telescopes.—The Gregorian telescope was the first of these, being the conception of Dr. James Gregory, a Scotch astronomer. His plan was published in an optical treatise in the year 1663, but was not practically tested till many years afterwards, for although the inventor had the specula for a telescope of this kind cast and ground in London, pressing business permitted no actual test, the reflectors being only roughly mounted without a tube.

The principal speculum, A B, Fig. 5, converges the parallel rays to a focus at F, diverging from thence, they impinge on the smaller ellipsoidal concave, C, which has its optical axis common with that of A B, one of its foci at F, and the other at *f*. A second image is consequently formed at the latter point, where a circular aperture in the larger speculum A B, allows the observer to view it with the eye lens.

A study of the action of the two mirrors, A B and C, will show that apparently any departure from the parabolic and elliptic curves would cause confusion in the image at *f*, by introducing spherical aberration; but practically, either curve may be modified to simplify the figuring, with good result. For example, if the larger speculum were over-corrected for parallel rays, *i.e.*, figured beyond the parabolic to the hyperbolic curve, the rays reflected from the margin would be longer than those from the centre, the reverse it may be noticed, of reflection from a spherical concave surface, and such an over-corrected principal would require a spherical secondary speculum, because the second reflection being from a spherical concave surface, would tend to shorten the marginal rays, and so reverse the error of the first reflection.

The specula are placed at a distance apart, slightly in excess of their joint focal lengths; and any varia-

tion of that distance, necessary to secure distinct vision, is obtained by causing the smaller mirror to approach towards, or recede from, the larger, by a fine screw motion. Owing to the second reflection, the focal image at *f* is erect, in the same position as the object.

The Cassegrainian Form is the second in point of date. Its plan first appeared in a French paper about the year 1671. It is illustrated in Fig. 6; A B is a parabolic reflector, which would converge parallel rays to a focus at *f*, but before the focus is formed, the converging rays are intercepted by C, a small convex speculum of a hyperbolic curve. This reflects them less convergent, back towards the larger speculum, a focal image is formed at F, and viewed with the eye lens, as in the Gregorian telescope. The second reflection being negative, only one real focal image is formed, and that is inverted.

The remarks respecting the possible variation from the theoretically perfect curves for specula of the Gregorian telescope, apply also to the Cassegrainian, since the larger mirror of the latter may be of elliptic section (or under-corrected), and the smaller convex, spherical, with a resultant perfect image. The specula are placed apart, at a distance equal to the difference of their focal lengths, thus rendering this the shortest form of reflecting telescope. The aberrations of the two curves used in the specula of the Cassegrainian telescope are of an opposite nature. "These principles," writes Ramsden, "made me prefer Cassegrain's construction of the reflecting telescope to either the Gregorian or Newtonian. In the former, errors caused by one speculum are diminished by those of the other."

The third form is the Newtonian. It is a modification, by Sir Isaac Newton, of the Gregorian telescope. He first described it in a paper in the "Philosophical Transactions" for 1672, where the facts which led to the invention are detailed. "I saw it necessary," he writes, "to alter the design . . . . and place the eyeglass at the side rather than at the middle;" which alteration, as will be seen by reference to Fig. 7, is still retained. The principal speculum, A B, is of parabolic curve. A plane reflector C, is placed at an angle of 45° with the optical axis of A B, at some point between that speculum and its focus for parallel rays.

The small reflector is optically flat, and of such a size and shape, as to divert all the reflected rays to a focus at right angles to their original course, where the observer may view the focal image without obstructing any of the incident rays other than those intercepted by the small plane mirror C, and its mounting. A total reflection prism is occasionally substituted for the plane reflector, but as its manufacture bears about the same comparison to that of the flat, as the working of an achromatic object-lens does to the working of a speculum, I shall merely mention its existence here.

This form of telescope, the Newtonian, owing to the simplicity of its theory and construction, is that which the amateur is recommended to adopt; and the information specially necessary to the manufacture of the Gregorian and Cassegrainian forms, will be reserved until the Newtonian is finally disposed of. The great difficulty in the construction of the latter forms, is the working of the small mirrors to the required curves. This difficulty has led to the adoption of a system of "matching" similar to that suggested when describing the Gregorian telescope. The aperture in the large speculum, also slightly affects the prospect of a true curve being easily obtained by an inexperienced operator.

The Herschelian, the fourth form, was used by Sir W. Herschel first in 1776, and finally adopted for his great reflectors. In this telescope the smaller mirror is entirely absent, the large reflector A B, Fig. 8, being tilted in its tube so as to receive the rays of light at an oblique incidence, and reflect them to a focus at the side of the tube, where the (inverted) focal image is formed and viewed direct. This construction is suitable only for large apertures, although it has been suggested by a good authority as that which an amateur should first attempt; for if the focus be greatly lengthened in proportion to the aperture, the angle at which the mirror must be tilted, and the spherical aberration in the reflection are both reduced.

Many attempts have been made to vary the forms just described, and of these a combination of the Newtonian and Cassegrainian, by Mr. Nasmyth, of Manchester, might be noticed. A small plane reflector is placed in a Cassegrainian telescope near to the large speculum, and the rays, after reflection from the small convex, are diverted to a focus at the side of the tube, as in the Newtonian telescope. The compactness of the Cassegrainian is thus combined with the comfort of the Newtonian form, and as the eye-piece tube in the inventor's instrument was placed in the vertical axis of the mounting, the additional ease of observation compensated, doubtless, for the introduction of a third reflection with its accompanying adjustments and loss of light. Occasionally in this telescope, the plane reflector has a central aperture, so that part of the light is reflected to a focus at the side of the tube and the rest as in the ordinary Cassegrainian form. Two observers are then enabled to view an object at the same time with the same instrument.

Focal Length.—This is much at the will of the amateur, depending partly upon his taste, but mainly

on his ability to correct the spherical aberration, which has been shown to increase in proportion to the amount of curvature employed in the reflecting surface; and the shorter the focus, the greater will be the amount of curvature in a speculum of given diameter. Sir Isaac Newton recommended that the focal length should be fourteen times the aperture, but with modern methods of polishing and figuring, 9 to 12 times will be found sufficient up to 8 inches in diameter, the proportion decreasing beyond that with increase of aperture. A focal length of 8 feet being sufficient for a 12 inch speculum.

In the Gregorian and Cassegrainian forms the large mirror may be made of shorter focus than one of similar diameter for the Newtonian telescope. In small instruments the focal length and aperture may be in the proportion of four and one, increasing in larger instruments to six or eight and one. The size of the smaller mirror depends, as a moment's reflection will show, on its focal length, and can be easily determined: the proportions of the focal lengths of the larger and smaller specula, varying between six and one and eight and one. The aperture in the principal speculum should be slightly less in diameter than the small reflector.

The focal length of a speculum for the Herschelian telescope should be, as before stated, as great as is conveniently possible, from 12 to 16 times the aperture.

To simplify Figs. 5 to 8, a single eye-lens has been substituted for the compound eye-piece commonly used for astronomical purposes.

(*To be continued.*)

MY REPOSITORY FOR NEWSPAPER CUTTINGS.

By J. HALL RICHARDSON.

FIRST of all, permit me to explain what it was that induced me to make it. Its object was to meet "a long felt want." Some years ago an eminent editor advised me as a young journalist to "collect material." I confess that inexperience led me to disregard for a season the value of his counsel. Where was the use of collecting material, was my argument, when that work was done so much more satisfactorily by the compilers of almanacs, guides, histories, and directories annually published and highly esteemed for reference purposes? But it was not long before I discovered that admirable as these volumes are they do not cover the whole of the ground, and although indeed they preserve the bones, they make scanty attempt to embalm the flesh of current information. Consequently, with scissors and paste brush I set about repairing the deficiency by elaborately cutting from the newspapers of the day, wells of knowledge very seldom drunk dry. "I've not had time even to read my paper," is a very common complaint in these days of high pressure, and no one thinks of reading a journal two days old. And yet, as is well known, the best efforts of leading literary men frequently appear in the broad sheets, the life of which has been averaged at barely eight hours. Often in an obscure column may be discovered a gold mine pushed out of sight by the sudden influx of weighty intelligence which monopolizes the conspicuous places, and dwarfs by comparison all contemporary contributions that, although greater in permanent interest, have not the wonderful attractive quality possessed alone by "news."

But my system of scissors and paste soon broke down. The collection grew too bulky and became unmanageable. What service could a huge volume of print serve me, carefully indexed though it was, when I dared not cut its pages for the fear of spoiling the whole? Then the labour of pasting in was irksome and fiddling, and circumstances sometimes prevented the work from being done at the proper time, and so arrears accumulated. A more elastic system, under better classification was evidently required, and an opportune suggestion from an American friend gave me a clue to the solution of the difficulty, resulting in the construction of "My Repository." My sketches, with the few details added, will, I hope, explain the method of making it; but a few words may be allowed me to point out the use to which I put this cabinet. For a cabinet, or nest of drawers—it is, and nothing more—its contents being newspaper, magazine cuttings, and odd scraps of print. When I see something bearing upon a special subject in the paper I am reading, I snip it out, enclose it in an envelope, and put it temporarily in the bottom drawer, the smallest of the four which is without compartments. At my leisure, or immediately, if the opportunity is at hand, I write upon the left-hand corner of the envelope the title of the cutting enclosed, and in an index I enter this title against a reference number, this number then being marked upon the envelope. It is now ready for deposit in its proper division of the drawer, and it stays there until I am in want of it again. Perhaps when almost all recollection of the event chronicled has died out, and history repeats itself, a cutting may come in handy as actual "copy," to be incorporated with the news of the day, or it may form the theme of some suggestive leading article. In neither case am I the slave of a big book, and my pockets are not incommoded by voluminous prints.

A small envelope is all that I am burdened with, and it is a matter of indifference whether it is returned to its place or not, as no mangled sheet reproaches me with its absence.

Of course, I do not imagine that all readers of A. W. are professional journalists, but I dare-say many of them are similarly engaged when as members of local parliaments, writers of essays, or enthusiasts in any pursuit they busy themselves in "collecting material," to be given out with advantage when the occasion arises, and hence I hope that my contrivance may be found of general utility.

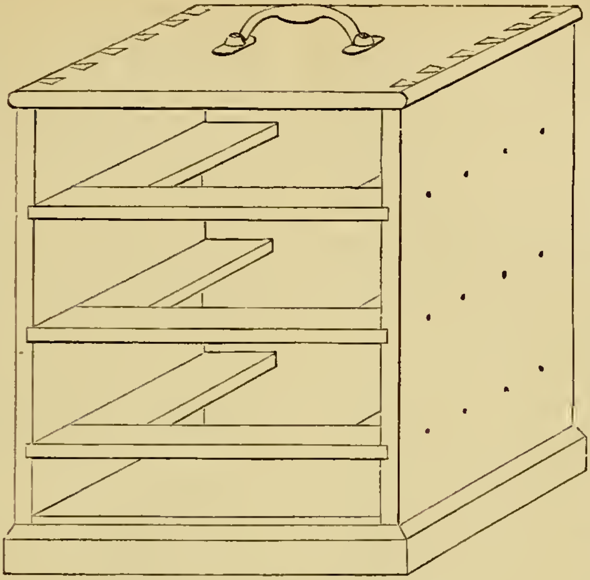
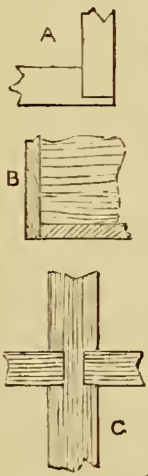


FIG. 1.—OUTER CASE OF REPOSITORY.

The illustrations show the arrangement of the divisions of the drawers, and the case for their reception. Fig. 1 gives a view in perspective of this case, the principal feature of which is the greatest lightness possible consistent with strength, for the handle on the top indicates that the whole is a piece of furniture easily to be carried from room to room.

Indeed, it is this consideration of lightness which has led me to adopt a system of making, that possibly from a purely cabinetmaker's point of view, may not be considered quite professional; but if others prefer more difficult and expensive work, I give them an alternative plan, which will be, in its proper place, explained. This latter mode, however, will entail a larger outlay upon material, as walnut wood or some harder variety than planed deal must be obtained. For all practical purposes, however, the softer and cheaper kind will suffice. As the drawers are the most important, I will deal with them first. The measurements must be carefully observed. They are — *Outside*, width in front, 13 inches; breadth, 10 inches; depth, $3\frac{3}{4}$ inches.

It will be noticed that each drawer (Fig. 2) is divided into six equal compartments, slightly under 6 inches long by $2\frac{3}{4}$ inches wide, and $3\frac{3}{8}$ inches deep; by inside measurement 1 in. These were determined by the fact, that if a three inch wide envelope be placed in a division $2\frac{3}{4}$ inches only in width, it cannot fall flat at the bottom, but at the worst must slant against the partition. And this is exactly what is wanted; for when you are running through a number of envelopes it is very troublesome to find them piled one on the other, but most convenient to turn them back, so that the angle they take presents their inscriptions readily to the eye.



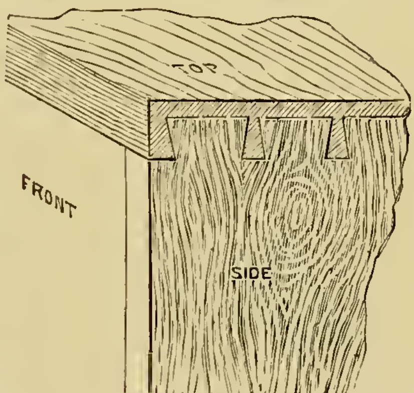


FIG. 3.—ALTERNATIVE METHOD TO DOVETAIL TOP TO SIDES.

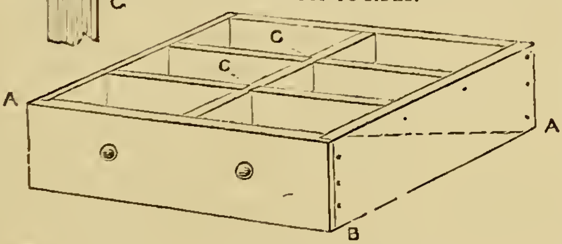


FIG. 2.—DRAWERS, WITH SECTIONAL DETAILS AT A, B, AND C.

A further use for the compartments may be found in the assistance which they give to classification; for example, one of them may be wholly reserved for "mysteries," another for "marriages," and a third for "markets." But it is not needful that you should bind yourself down to any arrangement of this sort, as a properly prepared index, with numbers corresponding to the envelope numerals, would provide, as I explained in my preface, a sufficient clue to the whereabouts of the desired cutting.

The sectional drawings accompanying Fig. 2, will give an idea of its construction. With the ex-

ception of the front, which is of $\frac{1}{2}$ in. stuff, all the portions are of $\frac{3}{8}$ inch wood. The front is what carpenters call "halved out," *i.e.*, it is not dovetailed to the sides, but depends for its stability upon the nails driven into it at each end, from and through both sides of the drawer. (See Section A, Fig. 2.) These sides are let into the front, which is "half cut,"—hence the term. The back is similarly kept in place by the nails which also make fast the hindermost extremities of the sides. The board at bottom renders the whole secure. An objection to this method of construction may be justly urged. The strain in pulling the drawer open falls entirely upon the front, and it depends upon the nails at the sides, and those fastening the bottom, whether it is not torn out by brute force. But bearing in mind that the contents are never likely to be weighty, I think it is not probable that the required amount of breaking force will at any time be exerted. The drawer with ordinary usage should remain intact. Still, if greater strength is wished for, the front may be dovetailed in the manner shown in Fig. 3; but it must be remembered that to get good work this part of the drawer should, in such a case, be not less than 1 inch in thickness, which will interfere slightly with the measurements quoted; and, further, that the bottom, instead of being nailed on over all, to the other portions, will needs have to be let in and held in position by fillets of wood glued to the sides underneath. An air space is thus provided; but the dovetailing has these drawbacks, (1) increase of weight with less room for envelopes; (2) greater depth of drawer, with no corresponding advantage. It may be added that the addition of say, $\frac{1}{2}$ inch to the depth of each drawer to allow for air space, would mean that the height of the outer case (Fig. 1) would be increased 2 inches, which it is desirable to avoid. This was my chief reason for rejecting the dovetailed ends.

In section C, Fig. 2, are shown the grooves which are cut out with a tenon saw, and chisel, in the longitudinal portions of the partitions, in order that the shorter cross-pieces may be inserted. Care must be taken not to cut too deep. Here and there a nail at the top will serve to maintain these fittings in place. Two of these nails are dotted in Fig. 2. The internal depth of each compartment is $3\frac{3}{8}$ inches.

Three drawers must be made to one pattern; the fourth differs in the particular that it is without partitions, and in outer depth it measures $2\frac{1}{4}$ inches only, otherwise it is identical with the others. In this shallower drawer, besides my index book, I keep a pair of scissors, some spare envelopes, and whatever newspaper cuttings await classification.

It is now time to deal with the outer case. The drawing (Fig. 1) shows the ends of the tenons, twelve in number, disfiguring the top. This unsightliness may be obviated by taking a board of inch walnut and dovetailing it to the sides as depicted in Fig. 3. The ornamental beading which gives a finish to the article, then would also conceal the joints; but the penalty to be paid, as I have pointed out in the regard to the drawers, is an augmentation of weight. Still, in principle, the alternative method shown in Fig. 3 is the correct one, as however great the dead strain upon the lifting handle, it would be impossible with the tenons arranged at the sides for the top to be detached from them; whereas, with the tenons as they are given in Fig. 1, theoretically, it is most probable that the upper part would be loosened from the under. Theory, however, is not always the same as practice, and I daresay that this contingency would never happen, at anyrate the chance of its occurring is so small that it need not be considered.

Should the alternative method be adopted, it would not be necessary to apply it to the bottom, which may be left as it is; that is to say, with the tenons or dovetails projecting $\frac{3}{4}$ inch, after the bottom board has been added. These dovetails afford the means for attaching the strip of bevelled 1 inch beading, which figures as an ornamental plinth. The measurements of the outer case are: Height, $16\frac{3}{8}$ inches; width, 14 inches; from front to back, $10\frac{3}{8}$ inches. Top and bottom are of $\frac{3}{8}$ inch wood, and the sides of $\frac{1}{2}$ inch wood. The latter are cut off a deal 10 inches wide. The back can be in two pieces nailed crossways to the sides; but bottom and top must be whole—viz., 10 inches wide, the odd $\frac{3}{8}$ inch making up the measurement from rear to front ($10\frac{3}{8}$ inches), being represented by the stoutness of the boards used for the back.

The sides must be cut to their full length ($16\frac{3}{8}$ inches), the dovetails at the top being $\frac{1}{2}$ inch in depth, and those at the bottom $1\frac{1}{8}$ inch, $\frac{3}{4}$ inch of which projects, as above stated. Internally measured the case should be exactly 13 inches wide; that is to say, the same as the drawers which are to fit it. A little planing down may perhaps be found necessary; but should the drawers be tight fits at first, the shrinkage in drying will make them loose in time. The drawers run upon light platforms formed by strips of $\frac{3}{8}$ inch wood, $1\frac{3}{16}$ inch in width. These are secured by brads to the sides of the case, into which they are inserted, grooves having been cut at proper intervals. Recollecting that the outer depth of the drawer is $3\frac{3}{4}$ inches, it will of course be seen that each rail is placed $3\frac{13}{16}$ inches lower than the one above it, starting from the top. The extra $\frac{1}{16}$ inch is allowed for the working of the drawer, as the area of friction is larger, and more play is needed than at the sides, where a shave or two of the plane will remedy any defect.

In conclusion, I may add that in the design of the cabinet I have striven to be unpretentious. Its merit is its utility, and the principle which prompted its suggestion is, I venture to think, capable of considerable development. Any such development would necessarily mean a modification of the design to suit special requirement, and this modification amateur woodworkers may safely be left to arrange for themselves.

SCREENS: FOLDING AND OTHERWISE.

By J. W. GLEESON WHITE.

I.—NOOKS AND SNUGGERIES FORMED BY SCREENS—CONSTRUCTION — FRAMEWORK — COVERING — HINGES—SUGGESTIONS FOR DECORATION.

IT seems but a few years since the folding-screen was looked upon as almost an obsolete piece of furniture, and, save in the coffee-room of an old coaching inn or the rambling rooms of some country-house, one was met with very rarely. No doubt many reasons led to the disuse of screens; perhaps the modern house was so assured of its comfort that it preferred to look upon draughts (if any outspoken visitor suggested their presence) merely as unsought-for ventilation, and felt that health and sanitation (a modern substitute for health) was best obtained by sitting in a temperature that, cosmopolitan in its variety, allowed the rich warmth of the tropics on one side with arctic cold on the other; or, possibly, the diminished size of the average modern room led to the banishment of the screen, for the fashion which led to cutting up the space formerly occupied by one, or at most two, rooms, into the *suite* of reception rooms so loved by the advertising house-agent, who lingers over the catalogue of them, dubbing the small —and often useless—apartments as drawing, dining and breakfast room, with library, in that eligible family residence we know so well. (No house-agent ever speaks in print of a house with rooms if he can substitute "a commodious mansion," "eligible dwelling," "desirable villa," or "recherche cottage ornée.") This rage for a lot of small rooms has destroyed the comfortable living-room of the old-fashioned middle-class home, in many country houses either adjoining the kitchen or itself actually boasting a kitchen range with spit, the last, it is to be feared, for exhibition only; or in town houses a spacious room with the best light and outlook in the house, and eminently a comfortable room, to be chosen rather than its alternative, the "best parlour." But the big rooms were doomed, and the small ones were built, and at once taken possession of by a centre table, which tyrannically usurped the best part of the room itself, and led to the unimportant accessories—chairs, people, etc.—being left to find a place where they could, while it, bearing its array of gaudily-bound books and general assortment of rubbish, dominated the room; but now the monarch is himself dethroned, and a democratic age, refusing to tolerate any power that comes in the way of its personal comforts and ideas, has left room for a quantity of small tables and chairs, with ample choice for any occupant of the room to sit where fancy may decide, and has welcomed as a consequence the folding-screen, with its comfortable shelter and the cosy little nooks that can be made with its help, while allowing as much clear space as the room affords whenever it is wanted. If by chance one is the fortunate tenant of a house boasting large rooms, it is possible, without detracting from the appearance of the room, to make most delightful little "snuggeries" for writing or work by the judicious use of screens—which need not be always folding ones, or if foldable may be so arranged as to stand flat if preferred—by some temporary fixing to the floor. Such a room I saw recently: near the door a screen breast-high shut off a corner devoted to one member of the house; here was a writing-table, small bookcase, and easy-chair, with the screen itself and the walls, hung with special photographs of friends and drawings, while the personal trifles of the owner were kept near, and in a graceful litter, without marring the effect of the room. Another part, shut off by another screen, was devoted to the mistress of the house; here files of papers and accounts, newspapers and books, showed that it served as a real workroom, while the fine library itself was in no way spoilt by what, if it had been in full view, would have been intrusive and disorderly. In a lesser room the screen will tell more as a draught-preventer, but, even here, may make a cosy nook for the piano or work-table, which, if the room is only used by one or two, makes it still more sociable, and if by a family gives a chance of special groups gathering together for the various amusements or work, with a substitute for privacy, if not actually affording it.

But it is too late in the day to need any special plea on behalf of the screen, as it has quite re-established its position in the household and is so often home-made, affording as much pleasure in its construction as it affords when completed and in its proper place.

It will not be possible, I fear, to say, "First take your screen (any screen will do), stick on some scraps, serve when cold, average cost £0 0s. 0d., suitable to shelter three to four persons"—in the style of the ever useful Mrs. Beeton, of household fame; but it will be better rather to see, first, how the ordinary screen may

be made at home, or to one's own pattern, next, to describe the many various ways of decorating it; and having done so in Grammar rather than Cookery Book style, to suggest as many exceptions to the rule as possible—but not, I hope, in the well-known grammar fashion, leaving the unhappy novice with a vague notion of the exceptions, but little, if any, of the rule itself.

The first part of the process is to construct the wooden frame of the screen. In most cases the covering completely hides the wood itself, so that common deal will answer every purpose. For a large screen, 5 ft. 9 in. or 6 ft. in height, with four leaves about 2 ft. in width, the framework may be built up of light stuff about 1½ in. square, or of inch stuff, using strips 2 or 2½ in. wide. The joints should be mortised, and one or two cross-bars added, to ensure stability and keep the supports true under the strain of the canvas, diagonal struts may be added, if desired, to keep each fold rigid. Having finished the woodwork, the next step is to cover it with a calico that will shrink when it dries. As this is so very important, it is best to distrust all advice and test a piece of the actual material first. Many say, use unbleached, but I can speak from experience of a most fearful result of one trial. I covered a screen with unbleached calico, warranted by the draper who sold it to shrink, but it would not; we tried boiling water, size, etc., but each application only added to its limpness—so that at length it hung like Indian muslin, or the folds of a Greek statue, graceful, but not the ideal covering of a screen. The ordinary bleached calico once gave the same result, so I would be very chary in taking any report of the material on trust, and try a piece before using. Having ascertained the shrinking quality, nail it with copper tacks on to the framework, either covering the edge so that the two sides meet at each edge, or nail-

FIG. 1.—A SCRAP SCREEN, IN WHICH THE FOLD TO THE RIGHT SHOW THE ARRANGEMENT OF COLOURED SCRAPS, THE OTHER PRINTS IN PLAIN BLACK AND WHITE.

ing it on the frame, gluing down the edge flush to the upright, which may be painted or stained.

It is by no means necessary to cover each side of the screen, but is preferable, and usually done, for many reasons. It is easier to mount pictures, if so covered; it is less easily perforated, as an accident that results in the piercing of one surface may not penetrate to the other; it hides the frame, which must otherwise be much more neatly made, and possibly of a more expensive wood; but if these are objections, the effect of a well-fitted framework nicely proportioned in its panels, and of dark wood, is by no means unsightly; and if the covering is lincrusta, or gold-leather paper, is rather a help than an eyesore by cutting up the plain surfaces.

Having covered the screen with calico, it should be well sized, and for the sake of a better surface to decorate, should have a good white paper pasted first over all the panels; or if a coloured ground be chosen of a thick material, either paper, calico, or American cloth scraps may be pasted to the covering at once; but if a thin coloured paper is used, it gives a much better surface when a previous lining of thick white or brown paper has made a perfectly flat surface. If American cloth is substituted for the calico, it will be ready to decorate at once; but I do not think it would form a good ground for printed screens, as the thinner prints would look dark from the material showing through them.

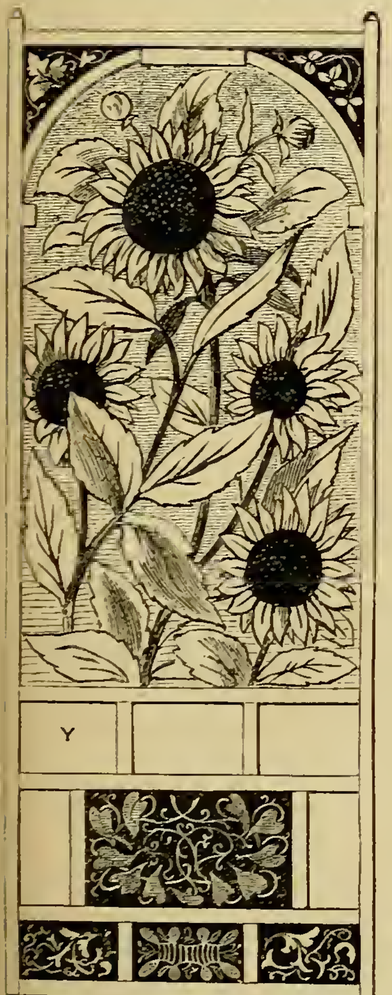


FIG. 2.—SUGGESTION FOR FOLD OF SCREEN.

FIG. 3.—SUGGESTION FOR FOLD OF SCREEN.

Hinges should now be added. The proper ones sold are much the best, as they are arranged so as to allow the fold to open freely in any direction, and, although rather expensive, will well repay the outlay. Ordinary hinges will suffice for many purposes; or even the webbing hinges, which may be studied from the kitchen clothes-horse, and need not be described at length here; but if these are made, they must be applied before the covering; whereas the other, when fitted, can be unscrewed so that each leaf is separate and portable—a very great help to its successful decoration, as it may then be laid on a table or taken to a good light; whereas, the whole screen being rather unwieldy, and in its half-finished appearance the reverse of sightly, must needs be done in some out-of-the way apartment.

The joints between the folds may be lined with velvet or any flexible material, to entirely exclude draught. This can be done the very last thing. A strip of velvet put on with brass nails is often used for this purpose, or it may be simply glued on.

The next portion of the work is one that to many would no doubt be the starting-point, as screens covered and ready for pictures to be pasted on are to be obtained at fairly reasonable prices in almost every upholsterer's shop; but the price of the lowest is, I think, so

far above that of the raw material, that where economy is desirable, it is far better to have it made (if the resources of the household are not equal to the task) by an ordinary jobbing carpenter under personal direction.

Among the many ways available for decorating the folds, the one that depends for its effect on an arrangement of "scrap" pictures being the most general, must be considered the first. It will be evident, without experiment, that prints in black and white and coloured pictures do not harmonize if used in the same panel, and as the ordinary print affords, from its infinite variety, a more easily-obtained stock, we will devote the first part of our description to prints. The method (if it can be so called) of haphazard arrangement of the prints, either cut out or as published, is not worth noting; nor is it, I think, worth mentioning, save as a warning, that some screens are decorated with black and white prints cut out and stuck on a bright, staring ground or an equally obtrusive black one. It may be that a success could be gained in this way, but personally I have never seen one; nor have I ever found a hint of any plan that would be other than "spotty" and crude in its appearance, however neatly done. It will be found, in nearly every case, that for the black and white side a carefully-planned disorder and an artistic medley will be the most satisfactory, and give the greatest interest to the pictures when examined, with the most pleasant background effect, when the screen is in use; and this is such an important point that it is worth distinctly emphasizing. On no account can the screen be considered successful, however carefully chosen, nor with the pictures themselves of the greatest beauty, if the effect at a distance is a loud, obtrusive one; at the length of the room it should tell as a quiet, neutral broken grey, and not show any picture more prominently than its neighbours. Of course, this applies to the mixed treatment with cut-out scraps, and not to special arrangements noticed elsewhere. Next, as to the choice of subjects. As the mass of black and white work is at every one's disposal in the present day of illustrations, there need be no excuse for using any but agreeable subjects; and while the taste of the individual will be widely different as to what is agreeable, there are yet, I think, two or three broad rules that might apply in nearly every case. One easily carried out is to exclude from an ordinary screen all modern fashionable dress, which, changing as it does, so rapidly, gives a vulgar and tawdry appearance to what to-day is considered exactly the reverse. Of course, this exclusion would not apply to *costume* screens, where a sequence of fashions during the present reign, or any other chosen limits, would impart a distinct historical interest; but if modern attire is used in ordinary work, in a few years the effect is quite changed. Some ten years ago the present writer covered a large screen, taking great care to carry out this rule of exclusion; and now it would be impossible to tell from internal evidence that the screen was not done recently.

When one considers the enormous variety of other subjects to be chosen, such as pictures of classic and mediæval times, with all their wealth of costume and accessories, national costume and travel pictures, with so much of interest and instructive quality as well, uniforms and court dress of every period, illustrations of famous authors, modern athletic and sporting costumes, grotesque and fairyland subjects, animals and birds, ships, sculpture and works of art, well-known characters, such as Pickwick, Punch, or even some modern statesmen or public characters whose fame makes their dress an historic incident and not the motive of the choice, it will be seen that the limit is not curtailed to any great extent, while the lasting interest is indefinitely increased by this first rule to exclude modern dress subjects.

Next it is advisable, when sufficient material is at hand, to keep each fold to a special class of subject. One might have landscape backgrounds and figures in outdoor attire. Another makes architectural backgrounds and interiors its leading motive, while naval subjects might occupy another, and so on almost indefinitely.

Perhaps it would be as well to try to note the details of a single page of the screen in the way I am trying to explain, although I fear it is a foregone conclusion, that is, impossible to describe it in any clear and definite manner. At the top comes a large picture, the "Weald of Surrey," by Birket Foster; this is pasted on uncut. At the side a rustic inn, of large scale, makes out the right width for the panel. The next row below has forest subjects of the size of the ordinary full-page "Graphic" or "Illustrated" print, *with the sky cut away*, and *the sides of the picture roughly cut to the outline.* This is difficult to describe, but important, and must be held to apply to all pictures, save the topmost row, so that each part is carefully arranged to avoid lines across, *i.e.*, a large picture is joined to a small one, tree over tree, with vistas here and there, a lawn or open space showing, until, at the foot of the panel, a large jungle picture, with its rank tropical vegetation, forms the foreground. Done in this way a complete background is obtained with little labour, hardly any waste of material, and a pleasant uniform tint. Now on the background so arranged are pasted groups of figures, sometimes in harmony with the subjects of the original pictures,

sometimes in quaint discord; for instance, a small figure in a forest glade is covered by a dog of larger scale; an angel floating through the air appears to comfort a small Elizabethan boy who is crying for a broken jug; two frogs gracefully saunter, in Griset's inimitable way, by a bit of sylvan beauty; while a group of classic bathers are disturbed by the stolid form of a policeman; processions of figures wander across bridges, the bridges themselves being taken from other surroundings and put to new uses. Of course, this is all by way of suggestion only, as everyone's taste, and the means at their disposal, would vary the arrangement.

In another, architectural subjects may be built up into an interior, when room after room is shown, with staircases and flights of steps leading from one level to the other, pillars and capitals being introduced to hide the joins of the prints, and many objects made up of entirely unexpected materials. I remember making an important-looking flight of steps, down which a procession walked, from the backs of the stalls in a picture of a rehearsal at Her Majesty's. I simply quote all these instances to illustrate the way to construct fresh arrangements and introduce effects, not existing in the original prints, and undreamed of by the artists who designed them.

It is doubtful whether figure subjects of large scale should be introduced in black and white prints; they are usually portraits, and refuse to work in with the other subjects at all, while the character of the work forbids sprays of foliage and flowers being used, as these rely on colour for their chief beauty, and come as a hopeless muddle in odd fragments of black and white.

To finish off these panels, a border of black and white should be used. This is not very easy to procure, at least I have not succeeded in meeting with it, and have found separated slips of ornamental pattern from the heading of a newspaper or advertisement sheet answer the purpose needed. I must also note how useful the lace patterns and much of the fancy needlework designs will be found as background in the interior panels. They give a decorative richness far more than the smaller details of the pictured background afford, and suggest rich tapestry hangings and elaborate dossals, which show off the figures to great advantage.

It will be best here in this black and white portion to let the part treated in the way just described, cover the upper two-thirds of the fold, while a dado of alternative square or other set pattern comes tile-like at the foot. To make this exact, get a piece of glass, cut to a square of about four inches, then with this laid over the picture, itself resting on a larger piece of glass, it will only need a sharp penknife run round the edge to insure a perfect square that fits well into its place (or a diamond or hexagon, if preferred). If these squares are mounted, using alternately a print of very dark character, and an outline or light subject, a chess-board-like effect (see Figs. 1 and 3), very decorative at a distance, is obtained with very little trouble; this part allows a quantity of unexpected matter to be utilised, such as figures from "Punch's" cover, Pears' soap advertisements, odd prints from the Dickens' serials, natural history works, art furniture catalogues, and the rest in infinite variety from the many millions of pictures that exist.

For the borders separating the different portions of the panels, mottoes formed of old English letters on some diaper or floral pattern would come very well, and give another feature of interest; they might be chosen either to describe the main subjects of the panels, or be "apt quotations, or terse proverbs," which would bear frequent perusal.

(*To be continued.*)

PHOTOGRAPHIC APPARATUS:

ITS PREPARATION AND CONSTRUCTION.

By J. POCOCK.

VIII.—PRINTING FRAMES — PORTABLE LANTERNS — DEVELOPING DISHES — VIGNETTING GLASSES — CONCLUSION.

HAVING now considered in turn the methods of manufacturing all the larger and more important pieces of photographic apparatus, we will, in this concluding paper, describe the construction of two or three different forms of printing frames, and give suggestions for an economical way of making a portable lantern, developing dishes, and vignetting glasses.

The best material for printing frames is undoubtedly oak or mahogany, and I recommend that no other wood should be used for this purpose. To make the printing frame shown in Figs. 71 to 76, half-plate size, take two strips of wood $8\frac{1}{4}$ inches long, and two other strips $6\frac{1}{2}$ inches long; all four to be $\frac{3}{8}$ inch in thickness, and a little over 1 inch in width. One edge of each of these pieces must be bevelled off, and the four are to be mitred and keyed together with their bevelled edges on the inner side, forming the frame, of which the front view is seen in Fig. 71 Two strips $\frac{3}{4}$ inch square and $8\frac{1}{4}$ inches long (Fig. 72) are now to be cut, and glued or screwed on to the back of the long sides flush with the outer edge, as shown at A A, Fig. 74. Four small pieces, of the

shape shown in Fig. 73, are to be glued into position B B B B, Fig. 74. Now take two pieces of wire, each $2\frac{1}{4}$ inches long, and bend them at right angles at the distance of half an inch from either end. These ends are to be inserted into the back of the frame, as may be seen at C C, Fig. 74.

For the hinged back to be used with this frame, cut two pieces of wood $3\frac{1}{4}$ inches by $4\frac{3}{4}$ inches, and $\frac{1}{4}$ inch thick, hinge them together, and bevel the top edges as in the illustration (Fig. 76), and glue a piece of cloth or felt on the under side of each half. Two springs of iron or brass are then to be made, of the shape shown in Fig. 75, and screwed on at D D, Fig. 74. When the frame is in use, these springs are pressed sideways till they catch into the pieces of bent wire, C C, thus holding the hinged back (Fig. 76) firmly against the sensitised paper and negative.

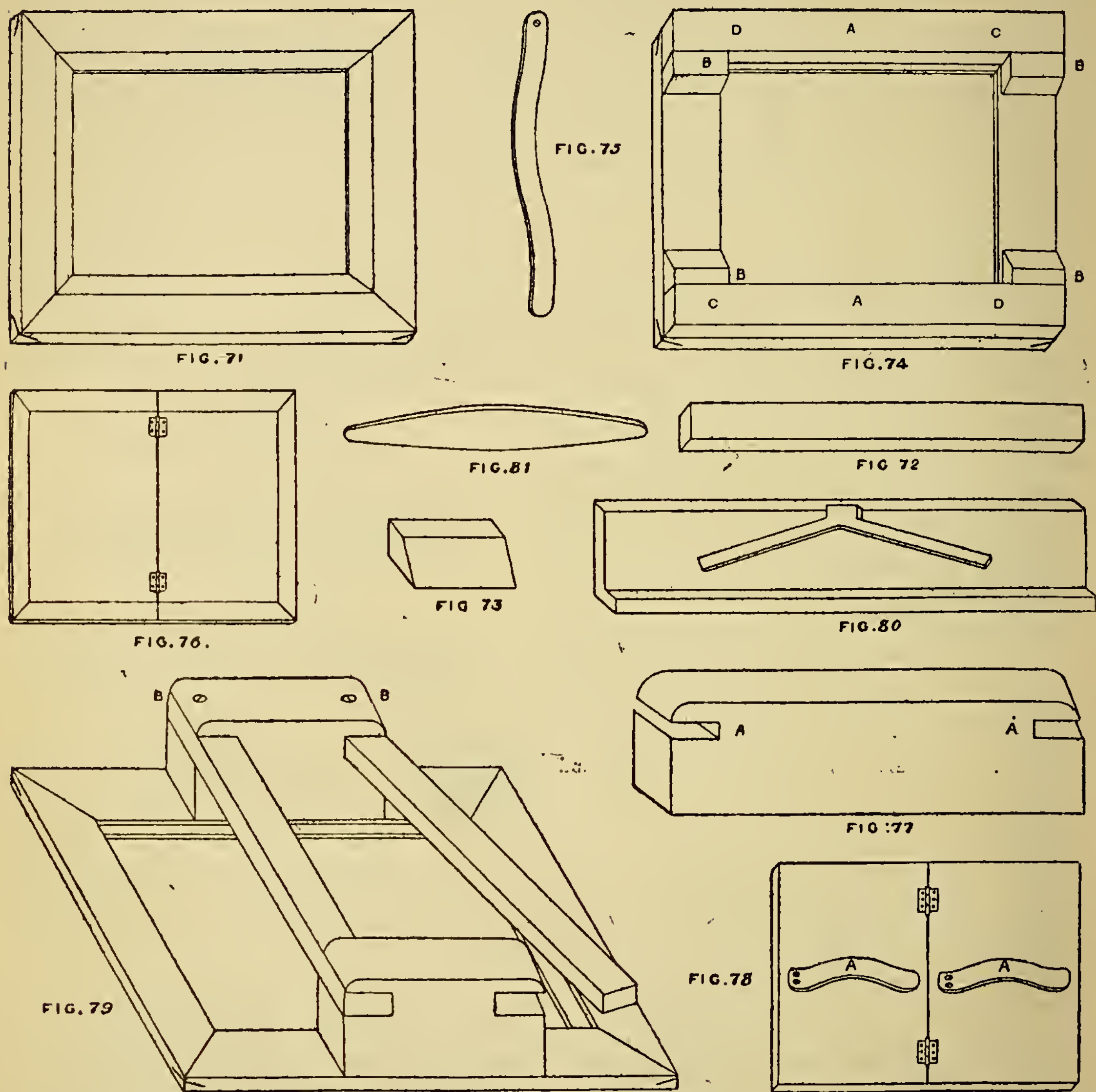


FIG. 71.—FRAMEWORK FOR PRINTING FRAME. FIG. 72.—PIECE FOR BACK OF PRINTING FRAME. FIG. 73.—CORNER PIECE. FIG. 74.—PRINTING FRAME. FIG. 75.—SPRING. FIG. 76.—HINGED BACK OF FRAME SHOWN IN FIG. 74. FIG. 77.—SIDE OF PRINTING FRAME. FIG. 78.—HINGED BACK FOR FRAME SHOWN IN FIG. 79. FIG. 79.—PRINTING FRAME. FIG. 80.—SIDE OF PRINTING FRAME. FIG. 81.—WEDGE FOR BACK OF FRAME.

For another form of frame, the earlier processes

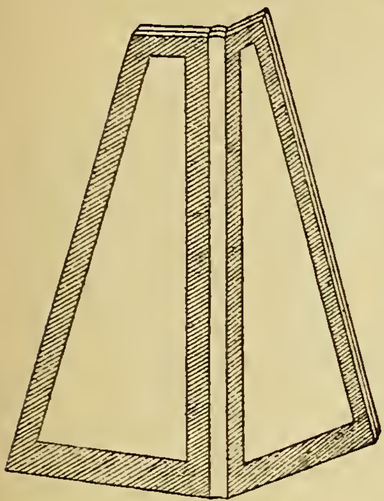


FIG. 83.—LANTERN PARTLY FOLDED UP.

are the same as those just described—that is to say, make a frame of 8¼ by 6¼ inches, outside measurement, having its inner edges bevelled on one side. Next cut two pieces 4¼ by 1½ inches and ⅝ inch thick, making notches in each ⅜ inch wide and ¾ inch deep, as shown at A A, Fig. 77. These pieces are to be fixed on the back of the frame (Fig. 79), and two other pieces ¾ inch wide ⅜ inch thick and about 6½ inches long, are to be slightly rounded at one end, and these rounded ends are to be screwed into the notches B B of one of the side-pieces, as indicated in the figure. The springs in this instance are to be made of the shape shown at A A, Fig. 78, and are to be fixed as will be seen on the movable back, instead of on the frame itself. Small wedge-shaped pieces of wood may be glued to the movable back instead of springs, but the latter will be found to answer best.

Fig. 80 illustrates one side of another description of frame. It is formed by four pieces of wood 2 inches wide and 5 inches thick, and of a length proportionate to the size of frame desired. These pieces must be deeply rebated and dovetailed together at the corners, the two longest sides being grooved on the inside before putting together, in the manner shown in the illustration. This groove should be about ¼ inch deep, and two wedge-shaped pieces are to be cut in the shape shown in Fig. 81. The back of this frame is made in the same manner as Fig. 76. There are no springs, but by means of the two wedges sliding in the grooves any amount of pressure can be obtained. Indeed, with this frame a thick piece of plate glass should be used in front of the negative, otherwise the latter is in great danger of being broken when the wedges are pushed in.

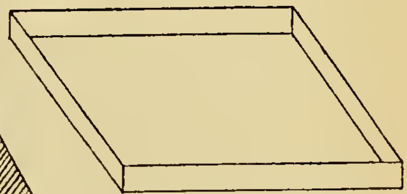


FIG. 85.—DEVELOPING DISH.

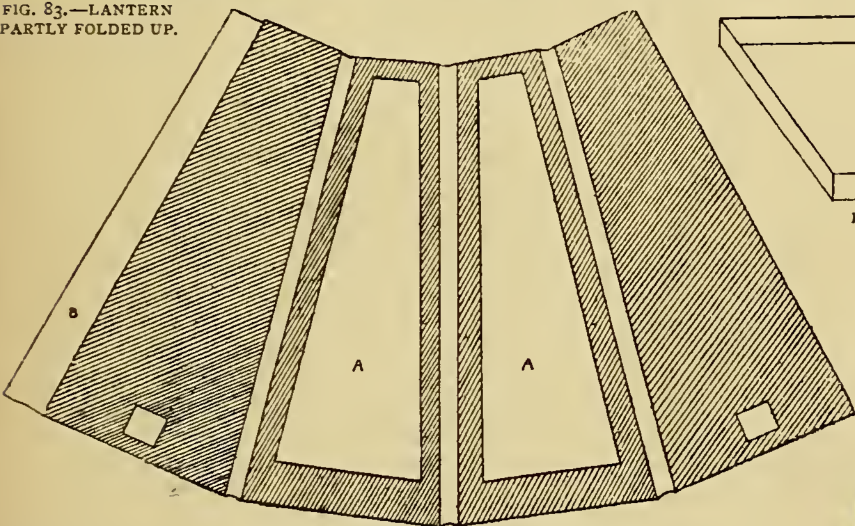


FIG. 82. — PIECES GLUED TOGETHER FOR LANTERN.

The next thing I will describe is a small folding lantern for use when we are changing plates. Take four pieces of stiff cardboard, 10 inches long and 3½ inches wide, and cut them to the shape shown in Fig. 82. Two of these pieces must have the centres cut away, and the spaces A A thus made must be filled up with a double thickness of waxed orange-colour paper or of ruby cloth. Two small air-holes, C C, are to be cut in the other two pieces, and behind these guards of yellow paper must be pasted on the inner side. The four pieces of cardboard are now to be fastened together with strips of leather just wide enough to allow of their

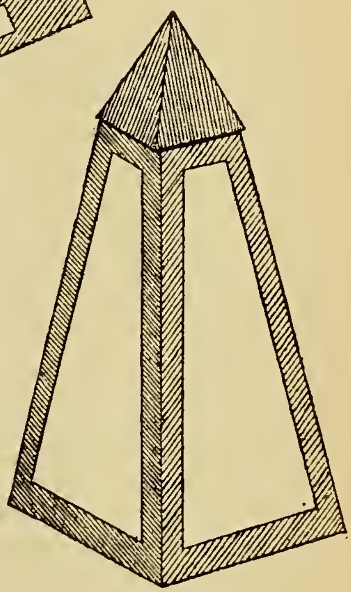


FIG. 84.—LANTERN WHEN IN USE.

being folded once, except the fourth piece of leather, which joins the two ends, and is indicated at B; this must be double the width of the other three. The pieces, when glued up, will be in the form of an obelisk; and a small pointed cap is to be made of the orange-coloured paper, to rest lightly on the top. A "night-light," or short end of candle that will stand by itself, is used inside. Fig. 83 shows the way in which the lantern is folded up, and Fig. 84 presents it as it appears when set up for use. Our readers will find it a wonderfully useful little lamp, and will probably be astonished at its neatness and compactness when folded together for packing or carrying about.

A few hints only will be needed on the subject of developing dishes and vignetting glasses. The former should be made about ¾ inch larger each way than the plates for which they are intended. They may be formed of thin wood, nailed or screwed together, and well dressed on both sides with melted paraffin; or they may be built up in a sort of papier maché with sheets of brown paper and bichromatized glue, each layer of brown paper being allowed to get thoroughly dry, and being well exposed to the light before the next layer is put on. Finally, the dish (Fig. 85) is finished off with a good coating of shellac varnish, both inside and outside.

Very good vignetting glasses may be constructed by cutting out the shape of the vignette required from a piece of tissue paper, which is to be pasted on to a piece of glass; an opening of the same shape, but ⅛ inch larger, is then to be cut in another piece of tissue paper, and this is pasted over the first piece, and so on, until eight or nine thicknesses of tissue paper, with graduated openings, have been pasted on to the glass which is finished by the addition of a piece of black paper, shaped like the others. Very good vignettes may also be printed by simply cutting a small opening in a piece of brown paper, and making snips round the edge of this opening. The brown paper is to be mounted on a cardboard frame, and placed an inch or two in front of the negative when printing. The snipped pieces forming the edge of the opening should be turned more or less up or down, according to the shape and gradation of the vignette required.

This paper brings to an end the present series of articles; but if any amateur should desire information as to the construction of any other piece of photographic apparatus, the writer will be happy to supply it, if it be in his power to do so. At present, however, he is disposed to think that every kind of appliance that the amateur photographer can make and use with advantage to himself has been described sufficiently for all practical purposes.

HOW TO CONSTRUCT A SIX-INCH WOODEN LATHE.

By OLLA PODRIDA.

V.—SOCKET AND T-RESTS, POPPIT HEAD, ETC.

SOCKET FOR T-RESTS.—We now come to the socket, or holder, for the T-rests. This socket must be made of cast iron. If a finished socket and rests, or castings for the same, cannot be conveniently obtained, then patterns must be made. The making of the requisite patterns will be comparatively a simple matter. Sound, dry, yellow pine, free from knots, may be employed.

Let us take the socket in hand first, and to obtain an idea of the necessary steps to be followed in making this, let us refer to the sketches. Fig. 45 is a longitudinal sectional elevation; Fig. 46, an end elevation looking from the left of Fig. 45; and Fig. 47 is a plan of the socket as it should appear when finished. Fig. 50 is a cross section through the foot at A B, showing the form of the slot which receives the neck and head of the holding-down bolt.

The casting will be made with the bottom of the foot uppermost in the sand when moulded. The pattern will therefore require to be tapered from thence in every direction perpendicular to that plane, as shown by the different views. The boss for set screw has an independent taper, or draught, of its own, of which more hereafter. The question of draught must be carefully studied and thoroughly understood. As a rule, amateur patterns are sadly deficient in this respect, and thus are frequently a source of annoyance to the founder.

In making the pattern, commence on the foot, which is made up of two thicknesses of wood, shown by the ticked lines in Figs. 45 and 46. Fig. 49 gives a plan of the bottom thickness, which is half an inch, as shown in figures at Fig. 45. Fig. 48 is a plan of the upper layer, or thickness, which is a quarter of an inch thick. In the bottom one a slot is cut to receive and clear the neck of the holding-down bolt, and in the upper one, another slot is cut to accommodate the head of this bolt. The outer edges of these pieces forming the foot should be finished off to outline after they have been fastened together. In putting them together, divide the upper and largest slot equally around the lower one, then fasten with a few small brads or wood screws.

The boss, shown at S in Fig. 51, forming the socket proper, may now be prepared and attached. In the absence of a lathe, this boss must be fashioned by hand, to the figured dimensions given in end view, Fig. 46. The easiest way of making it will be to

square up a piece of wood to the dimensions of bottom, or larger end—namely, two inches or a little over, to allow for cleaning. Cut it to the neat length, or height of boss, which in this case, is also 2 inches. Now centre each end, and describe circles $1\frac{3}{4}$ and 2 inches in diameter, to form the top and bottom respectively. Pare off carefully to the circles thus described, and finish with sand or glass paper. The boss is attached to the foot by means of a screw, as shown at C, Fig. 51, so that in being moulded, the parts may readily be disconnected at the option or convenience of the moulder.

The boss, or provision for set screw, may be as shown in full, in Figs. 45 and 46, or it may be carried down, as shown in ticked lines. The latter would be the most simple pattern to make, but the former has a much neater appearance. If the first named is preferred and adopted, then the small boss, B, must only be pinned on, as shown in Fig. 51, so that the moulder, by withdrawing the wire or pin, A, may be enabled to draw B back and remove it, after the socket S has been drawn. A "core print" must also be affixed, as shown at P, Fig. 51. This "print" should be $\frac{7}{8}$ of an inch in diameter, at the base or larger end, and tapered to $\frac{3}{4}$ of an inch in diameter at the smaller end, the total height being $\frac{3}{4}$ of an inch.

A core-box, wherewith the core for socket may be prepared, will also be required. Fig. 52 gives an end view, and Fig. 53 a plan of this core-box complete. It is made in halves, secured together by two wooden clamps, C C. Fig. 53A explains itself.

To make the "box," plane up two pieces of wood to the dimensions given by scale and figures. Mark on the inside face of one of these pieces a centre line running lengthwise with the grain of the wood, and square this line over each end. The preparation of the clamps being a simple matter, it will be taken for granted that they have been made, so that we may now clamp the halves tightly together, and fit the dowels shown at D D. These dowels are for the purpose of maintaining the relation of the halves when the box is complete. They are readily fitted by boring holes $\frac{1}{4}$ of an inch in diameter through one half, and about half way through the other half, as shown, round pegs of hard wood being driven in afterwards, the pegs being fitted tightly through the upper half, and freely into the lower one, so that the two parts may easily be separated.

At each end, and exactly on the centre line, and that of division, mark circles equal in diameter to the required size of core, which, in this case, is $\frac{7}{8}$ of an inch. Separate the halves, and carefully gouge out semicircular grooves in each, keeping carefully within the marks. This operation will be materially assisted by parallel lines drawn to the diameter from end to end, and still further by the use of a half-round gauge of similar radius to the core. A view of this gauge is given at A. Finish out the groove with sand or glass paper wrapped round a circular piece of wood suitable in size.

T-*Rests*.—These vary in form and dimensions according to necessity. Fig. 54 gives two views of a handy size for wood turning. Such rests are generally made of wrought iron, but I prefer cast iron, it being much cheaper, and quite as serviceable if properly taken care of. The pattern required for the form given would be simple in construction, and easily made, as follows :—

First plane up a piece of pine—mahogany would be better—to the section given in the end view of the

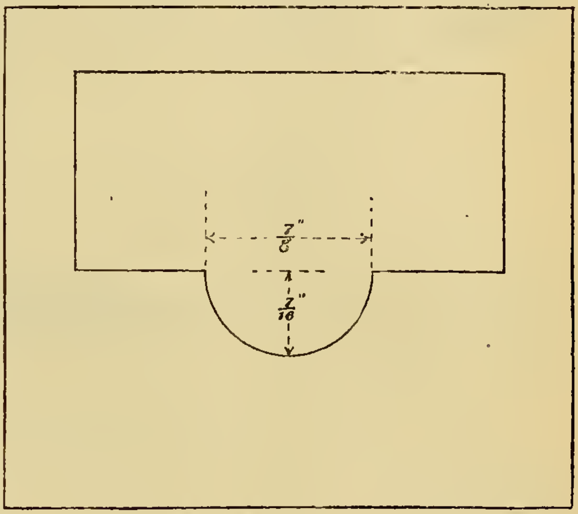
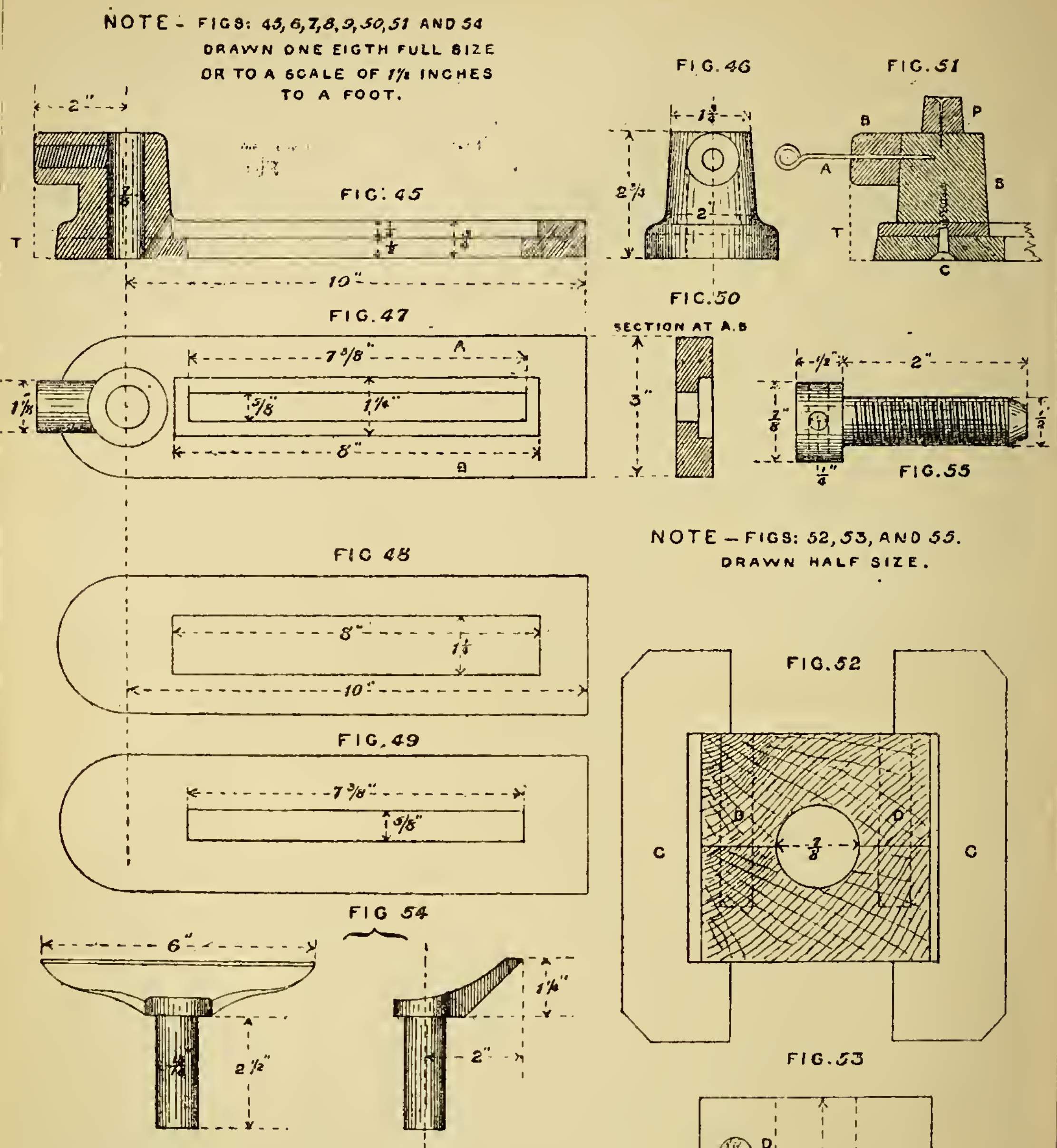


FIG. 53A.—TEMPLET FOR GUIDANCE IN MAKING CORE-BOX FOR SOCKET OF T-REST.

rest, and about six inches long. Having done this, shape it after the manner shown, or according to fancy, and smooth off with sand or glass paper. Now prepare a round piece of wood for the stem, and fasten the upper part to it. The stem should not be more than $\frac{13}{16}$ of an inch in diameter, thus allowing a $\frac{1}{16}$ of an inch clearance, to ensure against trouble in fitting it into the socket. The pattern for T-rest may now be considered ready. Most probably, on receiving the casting from the foundry, the upper edge on which the tool is rested, will be found partly "chilled," or so hard as to resist the file. If this is the case, recourse must be had to the grindstone, with which, combined with a little patience, an excellent surface may be obtained.

Poppit Head.—We now come to this part, details of which are given in Figs. 56 and 57. To make it, a block of wood $7\frac{1}{2}$ inches long, and $6\frac{1}{8}$ inches square, will be required. The grain of the wood should run lengthwise, or, when the head is in place, stand at



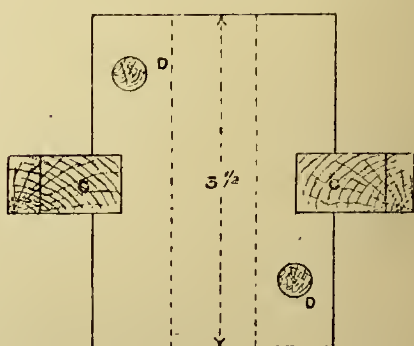
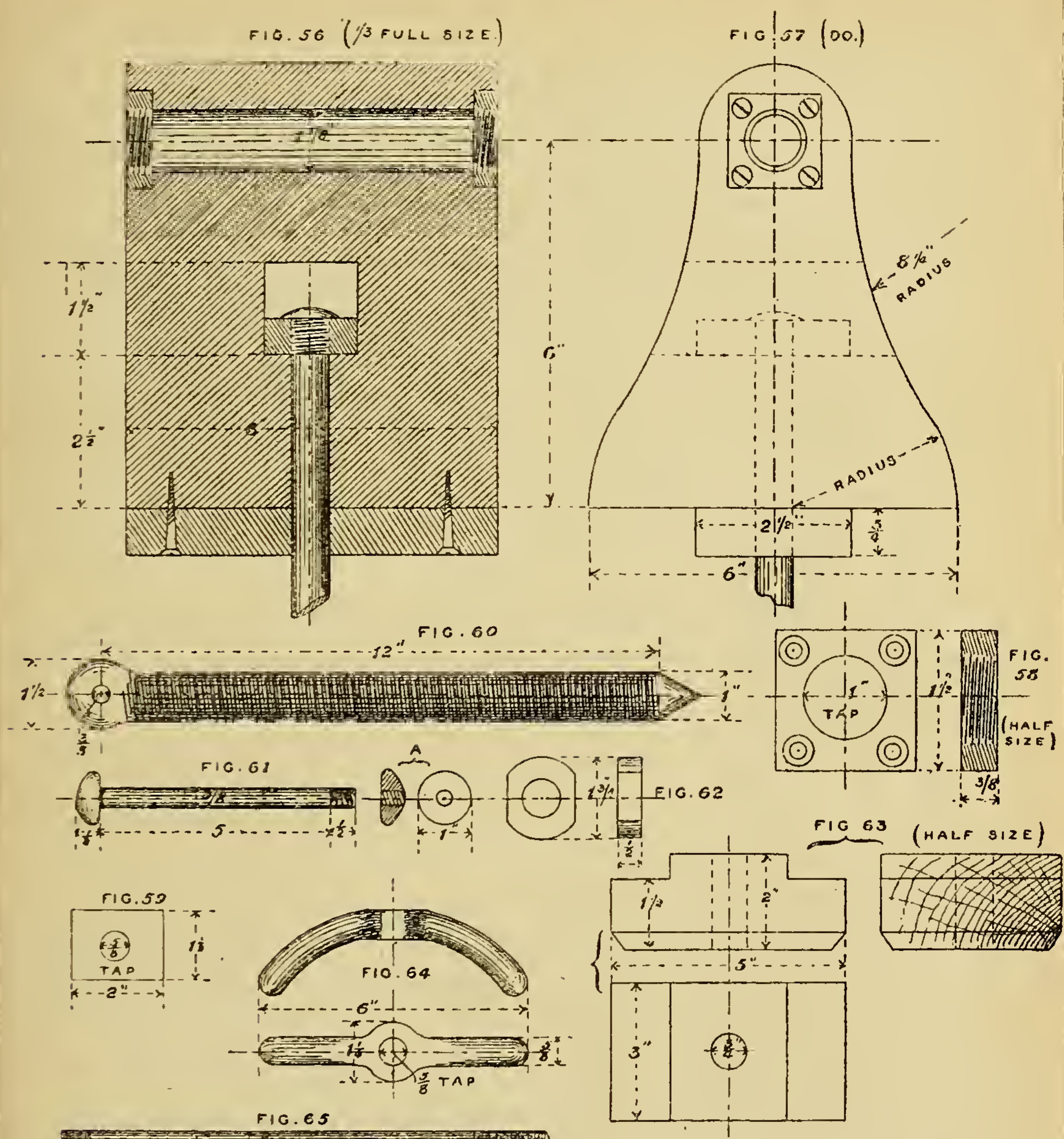
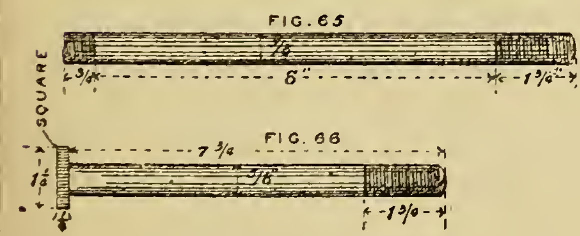


FIG. 45.—VERTICAL SECTION OF SOCKET.
FIG. 46.—END ELEVATION OF SOCKET.
FIG. 47.—PLAN OF SOCKET.
FIG. 48.—UPPER PART OF PATTERN FOR FOOT.
FIG. 49.—LOWER PART OF PATTERN FOR FOOT.
FIG. 50.—SECTION ACROSS FOOT.
FIG. 51.—SECTION THROUGH SOCKET, SHOWING METHOD OF MAKING PATTERN.
FIG. 52.—END VIEW OF CORE-BOX.
FIG. 53.—PLAN OF CORE-BOX.
FIG. 54.—FRONT AND END ELEVATIONS OF T-REST.
FIG. 55.—SET-SCREW FOR REST.





Note.—Except where stated otherwise, all Figs. are drawn one-fourth full size, or to a scale of 3 inches to a foot.

FIG. 56.—VERTICAL SECTION OF POPPIT.
FIG. 57.—END ELEVATION OF POPPIT.
FIG. 58.—PLATE NUT FOR CENTRE.
FIG. 59.—SCREWED HEAD FOR BOLT.
FIG. 60.—CENTRE FOR POPPIT.
FIG. 61.—TOMMY HANDLE FOR CENTRE.
FIG. 62.—LOCK-NUT FOR CENTRE SCREW.
FIG. 63.—WASHER FOR SECURING BOLTS.
FIG. 64.—HAND FLY-NUT FOR SECURING BOLTS.
FIG. 65.—SECURING BOLT FOR POPPIT.
FIG. 66.—SECURING BOLT FOR REST.

right angles to the bed. The timber employed should be hard stuff, if obtainable.

First plane up the sides chosen for front and back ends. Make them truly parallel with each other. Now square one end to form the base or bottom part of the head. Do this carefully, seeing that it agrees with the sides which have already been planed. Square a centre line across the base, joining the planed ends, and on each planed end square up a line from that on the base. On these end lines mark off the height of the lathe centres—namely, 6 inches from the base. This height should be taken from the actual of fast headstock which, it is assumed, has been completed. From these centres describe with $1\frac{1}{4}$ inch radius a circle on each end. These circles are for guidance in shaping the upper part of head. The curves at the base are struck with a 3 inch radius, from the intersection of the centre line and corner or edge of the base, and the sides or intervening parts are hollowed out to a curve or sweep of $8\frac{1}{4}$ inches radius, or they may be left straight, according to fancy—or laziness.

The hole to clear and receive the screw should be bored, and the plates forming the nuts let in and fastened before shaping the block to the finished outlines. The hole may be bored from each end by hand, or in its own lathe, a wooden chuck for carrying the bit being screwed on the mandrel, and the temporary cone pulley already referred to employed. The plates forming nuts for the centre screw must be carefully let in, so that the heights of poppit and mandrel centres may agree. The front nut should be fitted and secured first, then the back one put on the screw, which must then be passed through the head and screwed into the front one. This done the screw must be set level or parallel with the base of the head and the back nut run up against the wood, and its position marked. Care must be taken in letting in this back nut, so that it may agree with the front one, and with the thread or screw, as otherwise the screw thread would "seize" or "jam" in the nuts if not in proper relation. Should the screw work tightly, an examination of the thread will show where the fault lies. If when the screw is withdrawn the threads show signs of pressure on the right hand, or side next the "handle" end, then the back nut has been let in too deeply, and requires packing up, or out, a little. A thickness or so of paper may settle this, or a fraction of a turn back on the securing screws at the corners of the nut. If, on the other hand, the screw, on being withdrawn, shows signs of rubbing, or undue pressure on the left hand side of the thread, or nearest the nut, then the nut has not been let in deep enough, and must be taken out to allow of the recess being deepened. In doing this very little must be taken off at a time, it being better to make two or three trials than run the risk of taking off too much in trying to save time.

If preferred, one nut only may be used, and that at the front end. In this case the hole must be bored so that the screw may be a moderately tight working fit. In fact, if hard wood, such as beech or hornbeam were employed, the iron nuts might be dispensed with, the screw being tapped directly into the wood, and an arrangement similar to that shown in Figs. 7 and 8 for tightening the mandrel employed to grip the screw and hold it firmly while in use.

For steadiness and endurance two iron or brass nuts are to be preferred, but the last-mentioned arrangement, namely, that in which the screw is tapped directly into the wood, will be found very serviceable, and, if the wood is hard and the screw kept lubricated, comparatively enduring of wear; and, further, this much may be said in favour of it, that when the thread gives out in the wood the hole may be enlarged to clear the screw and nuts fitted as previously described.

The poppit head is secured by means of a bolt, or stud, shown in Fig. 65. This bolt is screwed at both ends, the short screw on the left hand being for the purpose of receiving the nut or plate forming the head. This head is shown at Fig. 59. As will be seen in Figs. 56 and 57, the bolt must be passed up through the hole in centre of poppit head, and screwed into the plate forming its head. This plate is fitted into a slot, or opening, cut through and across the poppit head, as shown. The slot may be readily made by drilling a hole $1\frac{1}{2}$ inches in diameter right through, and squaring out the *bottom* "corners." The upper side need not be squared. When the bolt has been finally screwed into the plate, the end should project about $\frac{1}{16}$ or $\frac{1}{8}$ of an inch, and be slightly riveted over to prevent it from slacking back.

The tenon fitting between the cheeks or sides of bed is fastened by screws to the base of poppit, as shown. Care must be exercised in doing this to ensure that the centre screw and lathe mandrel lie in the same planes, or correspond axially. This may be tested by comparing the point of centre screw and centre of mandrel as follows:—First, when the former is withdrawn, and, secondly, when it is advanced or run out to its full length. This being satisfied in every way, the tenon may be permanently fixed.

It will be noticed that the centre screw of poppit head and the nose of mandrel are of the same diameter and pitch. This will be found of great advantage in many cases, notably in drilling, as when work is mounted in a chuck, or held on a face plate on the live mandrel, drills may be held in suitable

chucks screwed on and advanced by the poppit screw, or, if required, the chuck, or face plate, carrying the work may be transferred from the live mandrel to the poppit screw, and the drill used "alive." The face plate can also be used as a drilling rest, a parallel thickness of wood being interposed between it and the work to act as a fence against the drill point.

Washers for the Securing Bolts.—These washers, drawn half size in Fig. 63, are of simple form, and will readily be understood. There are two required, one each for T-rest and poppit head. For each a piece of wood 5 inches long by 3 inches wide and 2 inches thick will suffice. The tenon part fits between the sides of the bed to prevent the washer from turning round. The grain of the wood, for obvious reasons, should lie across the bed. To give clearance for the securing bolts the holes for receiving the same are drilled ¾ inch in diameter. An ordinary iron washer must be interposed between the hand nut shown in Fig. 64 and the washer, to prevent abrasion of the wood.

This completes the wooden portions of the lathe. In the next chapter I hope to deal with the metal details, giving prices and where obtainable, also where possible, simple substitutes or alternatives for the minor details.

(*To be continued.*)

PRACTICAL LESSONS IN WOOD CARVING.

By E. ARTHUR EDWARDS.

VII.—HANGING WALL CABINET—BACK AND SIDES.

IT will, I think, be found easier to fret-saw the back as a separate piece, reserving the more elaborate sides for a future opportunity. The dimensions, moreover, will prevent many from accomplishing the whole at one sitting, as there are not many saws that will take in 17 inches by 17 inches; however, much greater stability would be obtained, provided the saw allows sufficient elbow room. The back consists of three distinct carved portions: 1st, that above the top shelf a veined outline design of rushes, etc.; 2nd, the T-piece surrounding the mirrors, both of which are shown in Fig. 21; and 3rd, the fluted angles under the cupboard. The whole length is 17 inches, and width (*back* only) 11¼ inches, allowing ⅛ inch on each side for tongue and groove joint. I have not space to give the fluted angles, but they are exactly similar to those at the bottom of the corner piece, and must be drawn to correspond before the back is sawn out. The position is clearly indicated at A in Fig. 22. The blank space between the second and third shelf serves as the cupboard back, and, of course, is not carved. All these drawings are given ½ inch scale, except the small sketch of the completed cabinet in Fig. 22, which will show the general effect when completed. The main outline has first to be sawn out, the sides squared up true for subsequent fitting, and then the mirror spaces, 4¼ inches by 2⅜ inches, and the rebates cut at the back. Two thin pieces of backing will be required to fit them when all the carving is finished.

The shelves should also be cut now. L M is 2 inches wide, O P, and R S 3⅜ inches, which also gives depth of cupboard, F, G, H, corner shelves, are seg ments of circles or nearly so, the sides being of corresponding lengths to those just quoted, and all are glued and screwed from behind. The mirrors (4½ inches by 2¾ inches) *oblong*, can be obtained from Harger Brothers, *Settle*, at 1s. each, and it is advisable to gum some thin paper on their backs, as a slight scratch may remove the quicksilver.

Now for the carving. In the first portion the practice in veining, as described in the last paper, should now bear fruit, and with a few rough trials, the lilies and rushes can be made very effective. Plenty of "shading" must be imparted to the latter especially, and care taken to show up the more prominent parts in bold relief. No stamping is necessary, as a good polish brings out the background to greater advantage. The border lines must be veined very carefully, and to a greater depth than the pattern they enclose, and they are immensely improved by the addition of a little gilding as a final touch. Should it be thought desirable to considerably enlarge the scale of this cabinet, and it would well repay the extra work involved, I should certainly carve this upper portion in low relief; it would necessitate very careful work, no doubt, but my chief reason for introducing veined outline is to give diversity of effect.

There should be but little difficulty in carving the oak pattern in low relief. The border line is wide enough to cover the rebate for the mirrors, and should be bevelled downwards towards the groundwork, which should lie quite 3/16 inch, or even ¼ inch below the surface. The ordinary rules apply, and there is no scarcity of example in nature. The groundwork should be stamped. Neither should any one get far wrong with the fluting at the extreme top and at the lower angles. If preferable, these latter may be treated as additions, and fixed to the back and sides when all is complete. Each depression should have the appearance of having been cut by one sweep of the tool, but I think the drawing will sufficiently indicate my meaning. Should, however, an example be required, it may readily be found on many a piece of

carved furniture, chairs particularly being often ornamented in this manner. And here I may suggest, *en passant*, that many a good wrinkle may be picked up by the inquiring mind from similar sources, for quantities of carved work, good, bad, or indifferent, can be seen in any old furniture shop. The addition of a little gilding to the raised ridges in the fluting is a great improvement, but this would of course only be done when the work is stained black, and then when the polishing is out of hand and quite finished.

poses. On a bolder scale it would be remarkably effective, and foliage of any sort creeping up imparts the necessary variation. The trellis ribs or laths should be carefully cut, so that each one may show in an unbroken line from end to end. Having finished the fret-cutting, take a small chisel, and make a slight incision to separate each lath from the enclosing framework, and then sink it to about half its thickness, so as to give it the appearance of having been nailed on behind, carefully preserving the straight line

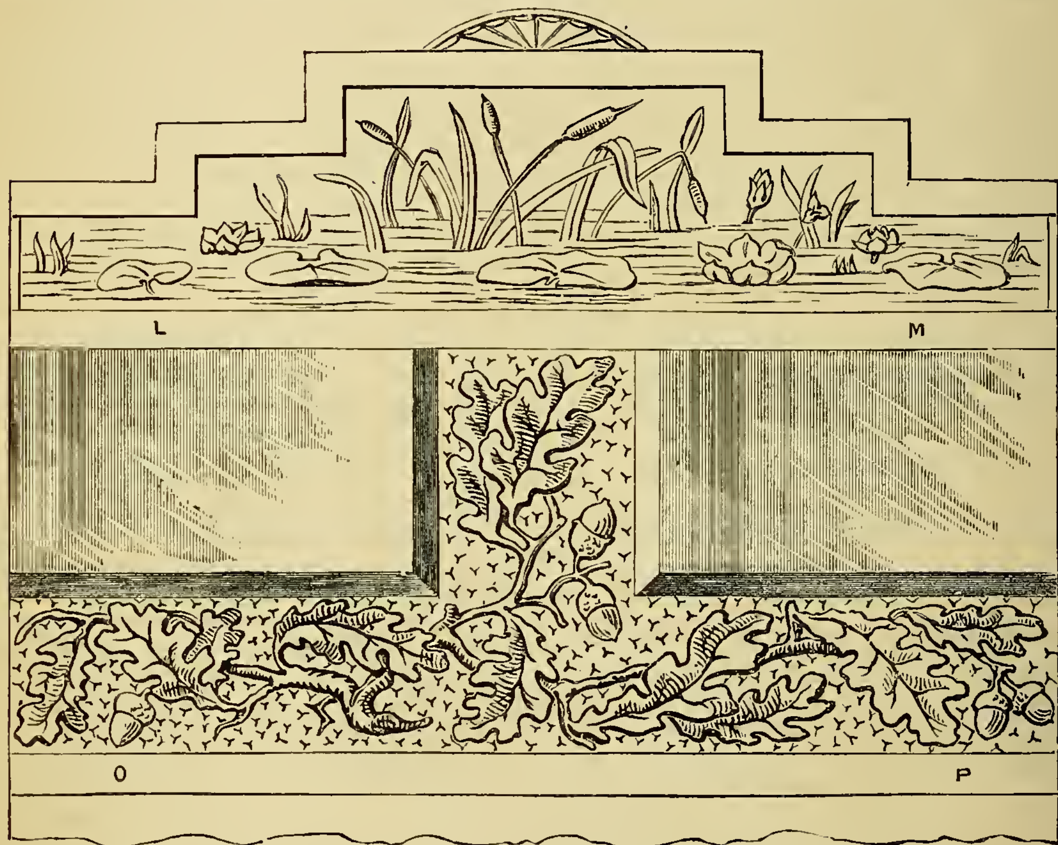


FIG. 21.—DESIGN FOR CARVING ON BACK OF HANGING WALL CABINET—HALF FULL SIZE.

Only one design is given for the sides in Fig.23, and if the suggestion for copying the corner pattern is adopted in this case, the reverse can be made use of for the right-hand side. I refer to the carbon paper process, and have had many proofs of its successful working when carried out with a little ordinary care. A decided and welcome contrast is gained by the fret-cutting, the *sides* showing up extremely well on a light wall paper, especially as in one of the cabinets I have made from this design, where the whole is stained black, and I hope I may here claim for my trellis design a special fitness for fretwork for various pur-

of the frame, and leave all the laths at present in the same plane. Then take the creeper (Virginian) in hand, and endeavour to make the stalk and leaves stand out from the trellis as much as possible. They do not want very much carving, every segment should turn over more or less, and some may disappear under the trellis ; but before beginning a leaf, make some plan for its disposition. The depressions would naturally occur *between* the squares of the trellis, and in crossing the bars the leaves would be elevated. In carving serrated leaves, I always do all the shaping and veining before I touch the iagged edges, treating

them in the first place as though the margins were entire, putting in the teeth quite as an afterthought with a small flat gouge specially sharpened for the purpose. The undercutting had better be left until the trellis is finished, as it interlaces with the foliage to a great extent.

There are two ways of arranging the trellis : 1st, as in the new ready-made stuff, where all the bars to the right lie above those to the left, and are nailed at each crossing ; 2nd, where the laths are pleated, so to speak, and cross one another continually. In a small pattern it hardly signifies which plan is adopted, but the first will I think be found easier to carve.

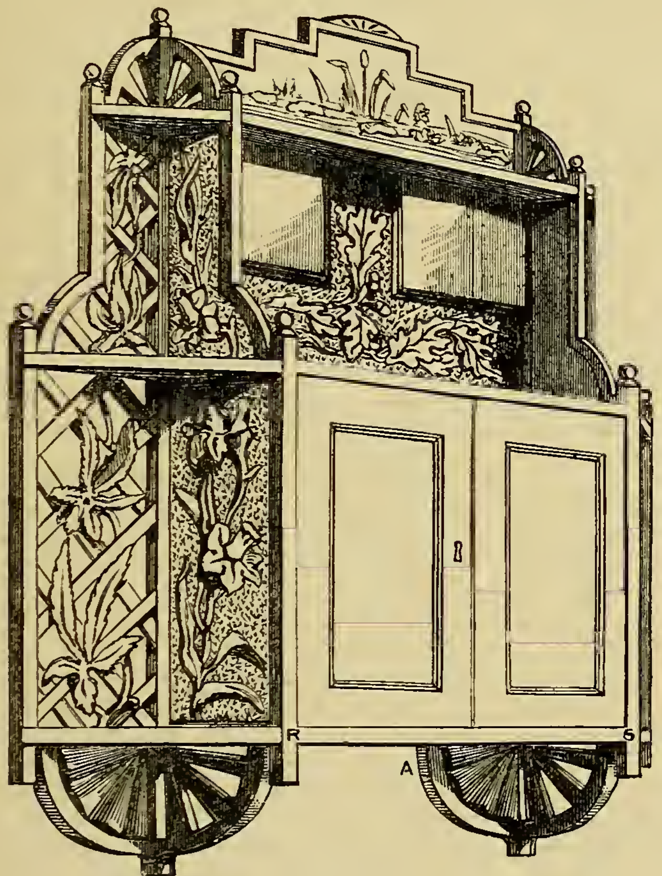


FIG. 22.—PERSPECTIVE VIEW OF HANGING WALL CABINET, COMPLETE.

There is, of course, the very slightest difference in the respective levels of each set of laths ; the upper set should not be much more than $\frac{1}{16}$ inch above the lower, as the wood is not thick enough to allow more.

It will be seen that a strong joint is imperative between the back, sides, and corners, but so much admirable matter has from time to time appeared in AMATEUR WORK on the subject of wood working, that it would be almost an insult to append any more definite directions as to the fitting up of the cabinet. However, should any one wish for further particulars on any knotty point, and state his difficulties, I will do my best to clear them up in forthcoming lessons—which, among other things, will contain designs for the cupboard doors—or in "Amateurs in Council."

(*To be continued.*)

FIG. 23.—DESIGN FOR CARVING AT SIDE OF BACK.—HALF FULL SIZE.

PRACTICAL SCENE-PAINTING FOR AMATEURS.

By HENRY L. BENWELL.

VIII.—ACT-DROPS AND PROSCENIUM WINGS.

THE act-drop is a picture or painted surface let down between the acts to close up the proscenium opening and so hide the work of shifting and re-arranging the scenes. As it generally continues in use for a considerable period—the one at Covent Garden has been there ever since the theatre was rebuilt in 1809—the drop is more carefully executed than back scenes, which, showy as they may be in effect, are required only for a season, and are, moreover, at a much greater distance from the spectators. As far, too, as pictorial effect and truth of perspective are concerned, a drop shows itself to far greater advantage than other scenery, which is composed, as a rule, of several pieces, constituting a set of scenes. I think I cannot do better than repeat tbe advice I believe I gave on a former occasion, and advise the novice not to attempt painting the act-drop until he has completed to his satisfaction one or two back-cloths. They require such a nicety of detail and finish, which an inexperienced hand fails to give them. Hence my warning.

The subject of the act-drop which appeared in the Folding Sheet issued with Part 43 is entitled "A Fairy Barque," and was suggested by a drawing by J. Moyr Smith, Esq., which appeared some time since in "Decoration," a high-class monthly magazine devoted to the fine arts. I was so taken with the subject as regarded its suitability for a small act-drop, that I painted one after the drawing, and have reproduced it in the sketch to which reference has been made.

Whilst on the subject, I should like to call the attention of my readers to the journal itself, and assure them they can always find plenty of matter therein which is of great practical use to the scene-painter and decorative artist. The publishers are Sampson Low and Co., and its price is 9d. per month.

The cloth on which the act-drop is painted is strained on to the framework in the same way as previously described for the back cloths ; and when the sizing and priming is finished—which should be most carefully done in this case—the subject must be drawn in with charcoal. The first thing to be done is to draw, accurately, the elliptical moulding which encloses the subject ; and as such a thing is often required in scene-painting, I will describe the various methods usually employed to draw a true ellipse, which will, no doubt, be found of use to others besides the scene-painter.

First of all ascertain, or rather decide, on the size of the ellipse, and proceed as follows, in Fig. 44 :—Place the given diameters, A B and C D, at right angles to each other at their centres E. From C with radius E A cut the long diameter at F F. These two points, F F, are known as the "foci" of the ellipse. Place a pin at F F, and another at D. Pass a string round the three pins, and tie it securely, thus forming a triangle of string, F F D. Take out the pin at D, and substitute a pencil, which may be drawn along, moving within the loop, and the point will thus trace a perfect ellipse—which, by the bye, is commonly, but erroneously, called an oval. This is one of the easiest ways for drawing an ellipse on paper, and will be found useful in getting out designs. For use on canvas, bent pins should be used, which can be easily inserted in the cloth without causing much injury to the material. For large work, however, perhaps the following plan will be found to answer best, as shown in Fig. 45 : Draw diagonals in each of the squares intersecting each other in G and H. From B, with radius B C, describe the arc C E. From D, with the same radius, describe the arc A F. From G, with radius G C, describe the arc C A. From H, with same radius, describe the arc E F, which will complete a true ellipse.

I will now give a few hints as to the painting of the act-drop, given in the Supplement. In the first place, the design should be carefully sketched in with charcoal, and afterwards gone over with some burnt sienna and strong size. To commence painting, begin at the top and lay in a sunset sky, and then put in the setting sun itself ; now paint the water, using as the basis a mixture of Dutch pink and indigo, and using for the high lights and ripples the colours previously used for the sky. This part of the picture should be so painted as to show the local colour of the sea, and also to partake of the tone of the sky and the reflections of the boat and figures. I shall give, later on, fuller directions in sea and sky painting, and treat on the subject generally ; therefore, I refrain from taking up much space on the present occasion, although this is the most difficult part of the work.

The boat and figures should now be laid in with some burnt sienna, mixed rather thin. This will give the finished painting a warmer tone. For the bottom of the barque use Vandyke brown, a little of which colour should be used for the reflection in the water. The upper portion of the boat is put in with sienna and a bright orange chrome, blending off up the swan's neck into almost a white ; the swan's head is painted white, eye a bright blue, and the bill black, lit up with orange. For the outlines and scroll on the bow of boat, use sienna. The sail should be mainly

of a white ground, but partaking more or less of the sun's rays towards the left. For mast and cross spar use sienna and lemon chrome, painting the ribbon a rich purple, and the garland green and chrome yellow. The figures are put in with a flesh tint, and shaded with a faint purple. The fish paint silver grey. The rest of the drop is painted to represent crimson plush drapery. This should be done carefully, to avoid splashing the picture. The corded moulding is executed last, and is painted as previously described in the chapter on Prosceniums. The drapery at the top of the proscenium is a separate piece of painting, and as the act-drop is generally hung a few inches away from this, when erected on the stage, they both show themselves as distinct features, which is not the case in the engraving. This strip of top drapery is, when painted, tacked on to a stiff batten, and is made so that it may be raised or lowered, according to the requirements of the scene, or the scenery in use. The borders are also worked on this principle, but this has to do with stage building, and cannot be touched on now. As regards drapery painting, a special chapter will be devoted to the subject at a later period, so we will pass on to the next drop, viz., that given in the cut, Fig. 42, the subject being Shakespeare's house.

Having made a sketch of the house exactly in the centre of the cloth, proceed as before, and then lay in the sky with some azure blue. For the tiles on the house use burnt sienna, putting in the shadows with Vandyke brown, rose pink, and indigo. The front of the house consists principally of plaster and wood, so it must, of course, be painted to imitate these materials.

For the wood-work the following will be found useful :—Yellow ochre and Venetian red, burnt sienna, umber ; burnt sienna and raw sienna ; and raw sienna. For the plaster, use yellow ochre and rose pink, using rose pink and ultramarine for the shadows. In painting the windows, lay them in first with raw sienna and a glaze of Vandyke brown ; afterwards glaze over again with indigo, and finish by giving a flicker of light here and there from the corners of the panes. Put in the foreground with rose pink, sienna and indigo, or brown lake. The rest of the drop paint to represent white or pale blue satin with gold fringe at bottom, and finish by painting the moulding round picture. The crimson drapery at top, as in the last instance, is painted separately. This act-drop is very easy, and requires very little skill in order to paint the subject in a satisfactory manner.

Coming next to Fig. 43, we have a picture which requires a little more colour, and which requires also more work being put into it in order to make it effective. First of all prepare the colours for the sky, which is one of those beautiful sunset skies so often seen in the east. Mix up in separate pots the following :— blue verditer, blue verditer and whiting, verditer and damp lake, lemon chrome and orange red, and orange chrome : the first-named should also have a certain proportion of whiting added or it will dry too dark, and it is as well to have another lighter shade of verditer ready mixed, in case it should be required ; as when the sky is once commenced there must be no stopping until it is completed, all tints being put in as quickly as possible while the canvas is wet. Having mixed the colours, commence laying in the sky at the top, using a two-tie, or a pound brush. Commence with the blue verditer (darkest shade), and cover the canvas right across about a foot from the top ; now, without changing the brush, proceed with the second and then the third shade of the same colour. Next dip the brush into the pot containing the verditer and damp lake and blend this tint carefully, but not too much, into the upper part of the sky ; then follow quickly with a little lake pure, and finish off at horizon with the orange red and chrome and the orange chrome. This, when dry, should have a nice effect, but if the work has been softened off too much, it will, on the other hand, have an opposite effect. The sky must in scene-painting be left somewhat harsh, the distance from which the picture is viewed doing the softening and blending If a few clouds are put in, which must be done at the same time, use Venetian red and azure blue mixed with a little white, yellow ochre and rose pink, orange red, and white. Never lose sight of the transparency in painting your skies, which can only be secured by gradation and variety. The amateur generally makes his sky look more like flat blue surfaces than the ambient air in which the sunlight moves, and through which the majestic clouds float silently on their mystic path. The reason for this is, no doubt, due to the painter not recognizing the necessity for subtle gradation, and that he has no feeling for nature's wondrous diversity of tint, tone, and colour. Before the sky has time to dry, the extreme distance, viz , the hills, must be laid in : these partake of the same colour as the lower portion of the sky, but of much darker tone, or it will happen that when seen from a distance (I mean the picture) they will become invisible, although perhaps they may show plain enough on the cloth at a closer glance. Next comes the middle distance, as the building on the left of cut, the foliage, and the still farther buildings in the centre. For these use the same colours, modified with more positive tints, and used somewhat stronger. Perhaps the orange chrome would do best for the high lights, using rose pink and a little verditer for the shadows. The water is laid in next, which should partake of the same colour as the sky, the distant buildings being reflected therein. Directions for painting will be given in a subsequent chapter.

The foreground requires more powerful colours, and, assuming that the artist has the outlines already marked out, he should lay in the whole with burnt sienna and strong size. The rest of the work must now be executed more boldly, the tower and buildings being laid in with pale chrome, and the shadows put in with a mixture of rose pink and verditer of a decided tone; the palisades are painted the same, but more decided still. For the trees next the tower use brown lake and green lake, and for the other foliage green lake and Dutch pink, and lemon chrome for the lights. Grass, etc., in the foreground may be put in with chrome green and lemon chrome, with a few dashes here and there of flake white. For the footpath use rose pink, adding a little blue for the shades. The trunks of the trees in the foreground may be painted sienna, orange red, and chrome.

The picture should now be gone carefully over, putting in a few more lights in one place and a little more shadow in another, and generally heightening the effect of the painting, and giving it a finished appearance. The artist will have frequently to retire to some distance when finishing off his work in this way, or he will never succeed. Should the picture be toned too much, all the outlines must be made more prominent, and several parts gone over again with somewhat darker tints, so that, in due course of time, what would have once looked like a mere mass of daubs and splashes may at last turn out a presentable picture.

In large theatres the act-drop, as its name denotes, is only let down between the acts of the unfinished piece, a plain green curtain being used at the end of the play, in order that the audience may know that the piece has terminated. In pieces that end very abruptly this curtain comes in very handy; but, as a rule, it is unnecessary, except as a change. The curtain is generally down when the doors of the house are opened, and rises simultaneously with the opening strains from the orchestra, disclosing the act-drop behind. This has a very good effect, especially as the gas is turned up at the same time. Curtains may be used entirely, and the act-drop done away with, when it is not found convenient or possible to paint one. These may be made of dark green or "plum coloured" baize, and arranged to work up and down through rings, or, opening in the centre, rise in folds partly to the top and partly to each side of the proscenium. They are also made of velvet and plush in any colour, but become very expensive in this material. They are generally known as tableaux curtains, and as it is useful for the amateur to know how to make them, I hope to describe the method in a future series of papers.

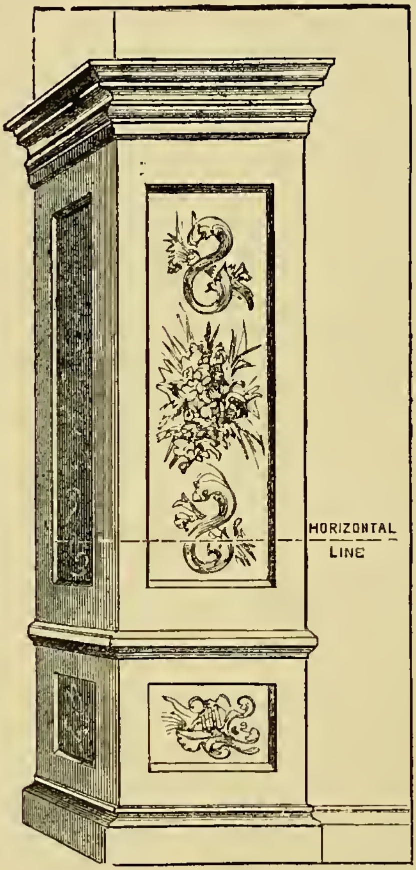


FIG. 48.—DESIGN FOR SIDE-WING.

I now turn to the subject of proscenium wings, *i.e.*, the pair of wings situated next to the proscenium. These wings, or side-scenes, are generally painted to harmonize with the proscenium, and are never moved. It is sometimes the custom to have the first border to match the proscenium wings, which is also, in this case, a fixture. The designs given in the accompanying cuts will prove suitable, not only for the purpose named, but if one or two extra pairs are painted, of either design, they will be found to come in handy for "palace" and other gorgeous scenes. Side-wings should never be less than three feet in width, or they will fail to answer the purpose for which they are intended, and that is to effectually cover the sides of the stage from the view of the audience. The proscenium wings can even be made wider still, they answer their purpose better, and can be pushed a foot or so on the stage, if the act-drop happens to be hardly wide enough, or the green baize curtain shrunk, which it will be sure to do to an alarming extent, especially if it gets damp. When the framework for the wings is ready, the canvas is strained over the frames and sized and primed as before. The next proceeding is to take a straightedge, and draw the design on the canvas as accurately as possible, and afterwards go over the work with a hoghair lining fitch and some sienna, still using the straightedge for ruling all the straight lines. If the reader will now refer to Fig. 46, I will endeavour to describe how it should be painted in order to look effective by gaslight. From A to B is a white ground, on which are three gold mouldings, boldly shaded. From B to C, put in a bright lilac tint

with some mauve paste, followed by the heavy moulding, in three colours — the gold moulding, and the scroll work. At D D we have a bright azure blue ground with bouquets of flowers painted thereon in

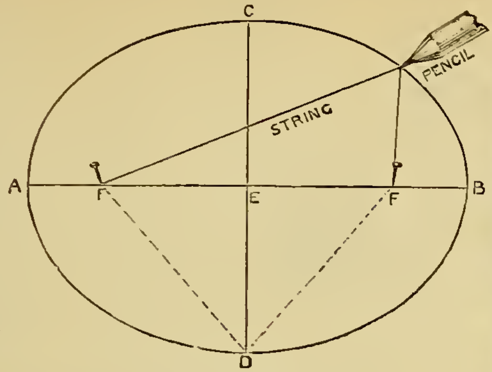


FIG. 44.—MODE OF DESCRIBING ELLIPSE.

plenty of bright colours; E, rose pink, very light pink tint; F F, beadings chrome yellow, shaded with Indian red; from G to base, put in a ground of lively grey, and at H, a ground of pale straw; for the upper part of column, use chrome and orange red, marking out lines with burnt sienna, and using flake white for the effect. At K, use damp lake and yellow chrome, and

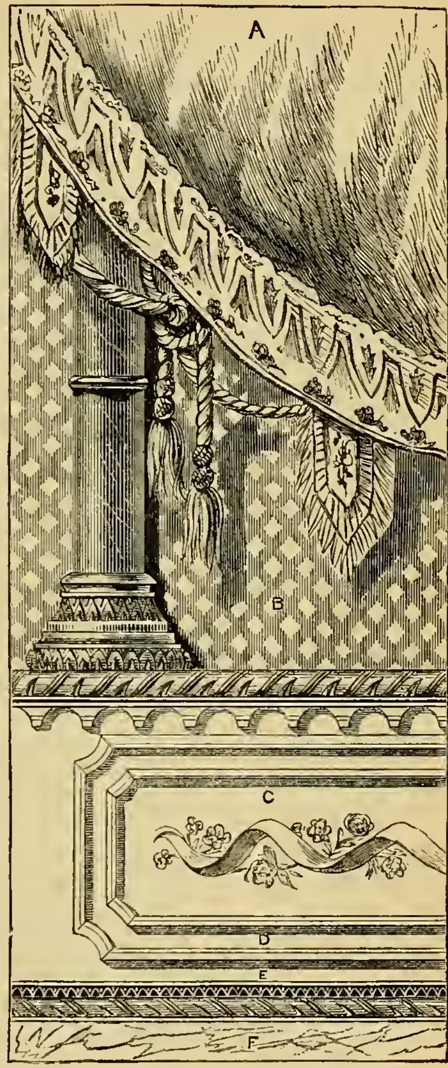


FIG. 47.—DESIGN FOR SIDE-WING.

finish off to taste. Fig. 47 may be painted as follows:—A, crimson lake, gold hangings, fringe and tassels, shaded with burnt sienna, and lighted up with sharp dashes of flake white, red and blue. The upper part of column

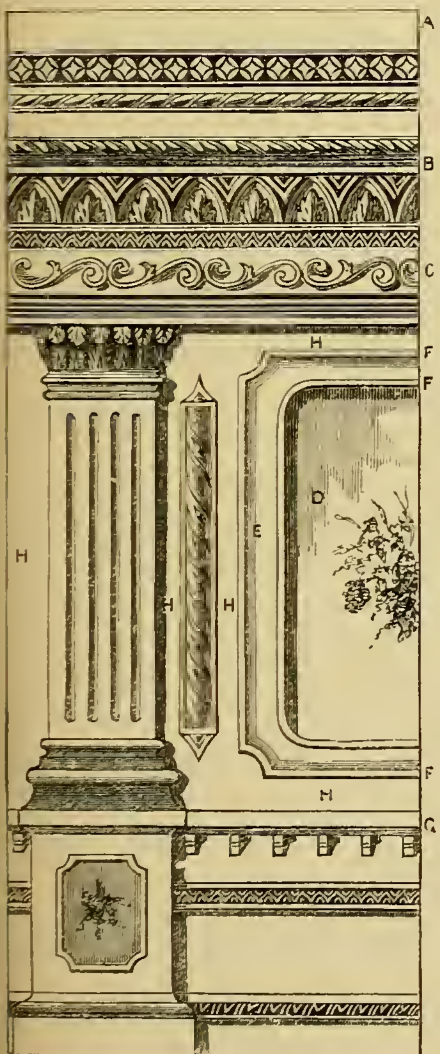


FIG. 46.—DESIGN FOR SIDE-WING.

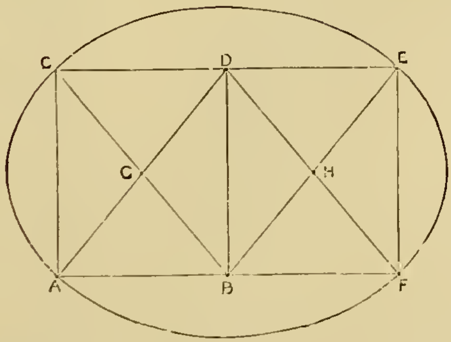


FIG. 45.—ALTERNATIVE METHOD OF DESCRIBING ELLIPSE.

richly marbled, but not too stiff, in fact, a few markings will look much better than too much work; B, diaper work put in with two shades, grey, blue or brown, of an undecided tone; C, azure blue, ribbon, damp lake and yellow, flowers to taste; D, buff tint; E, lavender or pink; F, white, marbled with blue veins. Fig. 48 may be coloured in a few simple tints. This cut is my first illustration of stage perspective. It will be seen that all lines below the horizontal line, on the perspective side of the diagram are so arranged as to come in with the bottom of the canvas which rests on the floor of the stage. I shall notice this figure more fully in the chapter devoted to stage perspective.

In the next chapter I shall commence to describe the painting of exteriors and back cloths, but for the benefit of those who wish to obtain, without delay, some suitable designs, I beg to draw attention to "French's Scenes for Amateurs," which may be obtained at 89, *Strand, W.C.* The price for the plain prints is 6d. each, but they may be had, coloured, at 1s. each. The following is the list of subjects :—

BACK SCENES. Size, 16½ inches by 12½ inches.

1 Cottage Interior [J B]
2 Cottage Exterior [A F]
3 Wood [A F]
4 Prison [C L]
5 Field [A K]
6 Castle [K]
7 Street [G]
8 Palace [D H]
9 Drawing Room [J]
10 Library [J]
11 Street (foreign) [E]
12 Roadside Inn, River and Bridge [K]
13 Foreign Hotel (exterior) [A F]
14 Ship Deck
15 Seascape [K]
16 Cave [C L]
17 Mountain Pass [B K]
18 Attic [B J]
19 Lodging House Room [J]
20 Villa [A F]
21 Court of Justice [H]
22 Baronial Hall [H B]
23 Proscenium (right half)
24 Proscenium (left half)
25 Curtain
26 Act-Drop

The letters in brackets denote what borders and side-wings will go with the scenes.

BORDERS AND SIDE-WINGS.

A Foliage Borders
B Rocks & Rafter Borders
C Stone Borders
D Fancy Borders
E Foreign (exteriors) Wings
F Tree Wings
G Exterior Wings
H Pillar Wings
J Interior Sides
K Field and Rock Sides
L Stone Sides

Amateurs, generally speaking, who are getting up a play and painting their own scenery, will find these designs both useful and suggestive. I would recommend those, however, who are only beginners in scene-painting to procure them coloured, as these will be more helpful to them than the plain ones.

(*To be continued.*)

THE LOCKED AND CORDED BOX TRICK, AND HOW TO MAKE THE BOX.

By DAVID B. ADAMSON.

(*For Illustrations, see Folding Sheet that accompanies this Part.*)

A SIMPLE looking thing, just a plain panelled box, not unlike a superior tool or sea-chest. No deception about it apparently, plainly and solidly made, two panels in front, one at each end, and two behind; corners strongly clamped with brass, a good padlock. Yes, it is a very innocent-looking thing, what can there be remarkable about it? Well, my friend, please remember that the words of the poet, " Things are not what they seem," are very applicable to conjuring apparatus. That box is so made that it is impossible to keep anyone knowing its secret, from getting into or out of it if his movements are free.

"Oh—ah—yes. Of course. Lift up the lid and get in or out."

Very good; but, my dear sir, suppose you were put in, the lid closed, the padlock fastened, and to make you doubly secure inside, the whole chest bound with several yards of rope, I am afraid you would not be able to get in and out by simply lifting the lid. You give it up. Very well, I will tell you " how it is done."

"Yes, that's what Dr. Lynn says, but his explanations never made things much clearer to me. You conjurors——"

No, dear boy, not a conjuror, only an amateur like yourself writing for amateurs. What do you say? Oh! Anything *I* can make you think you ought to manage. Why, certainly you can when you know how, and I am going to show you, though, mind, it is a great secret, quite between ourselves. You understand. If any of your friends want to know how it's done, recommend them to get the part of AMATEUR WORK in which the instructions appear, and they will be as wise as yourself.

"How did I find it out?" Well, I got it from a friend, a professor of the sublime art and mystery of conjuring and humbug. Only a rash man would vouch for the absolute truth of *quite all* the professor's statements while actually performing; indeed, my own private conviction is, *unter vier augen*, as the Germans say, that he wilfully deceives his audience. I know he sometimes—shall I say always—manages to do so. It is painful for me, as you say, to acknowledge that any man tells—ahem—but such is the fact. The professor enlightens me in matters pertaining to conjuring so far as to condescend to inform

me that his business is to deceive his audience, otherwise how could he do his tricks ; and that in doing any trick it is necessary to draw attention to things not important to the due performance of the feat being shown ; *e.g.*, in connection with the locked and corded box trick let spectators examine the lock, hinges and rope as much as they please, but don't call their particular attention to *the* panel, etc., on which all depends. The professor asserts that a good strong lock, when handed about for examination, affords a vast amount of satisfaction. Nothing like letting your audience examine your apparatus freely, *except* those parts on which the working of the trick depends. *Verb. sap.*

The trick with the locked and corded box, I believe, is an old one, though perhaps not in its present form. In late years it has been revived with improvements, and popularised by those clever illusionists, Messrs. Maskelyne & Cook, and Dr. Lynn, at the Egyptian Hall. There are several ways of working the trick, or rather, of arranging the special bit of mechanism wherein the peculiar features of the box consist. The one I am about to describe, is, I think, the best of those I am acquainted with, or at liberty to divulge. Indeed, I don't know that any method is better, and this one has the advantage over most others of allowing the performer to get into as well as out of the box, without leaving a trace of his means of ingress. It will be seen the box is panelled, and all the panels look equally firm and fixed. As a matter of fact, one of the panels is movable, though the closest scrutiny would fail to discover this if the box and fittings are carefully made and adjusted. Fig. 1 shows the general appearance of the box, of which the back is the same as the front. In the box I describe, the end marked + has the movable panel. The size of the box should be regulated by the size of the performer ; but one measuring 3 feet 6 inches long, by 2 feet back to front, and 21 inches high, exclusive of the lid, which may be 3 inches, will be of general use. In making the box it is most important that all sides and panels look alike, and that nothing special in the appearance of the end with the loose panel should attract notice. Fig. 2 shows this end with fittings drawn half of full size, and it will be seen from this, that the framing A is 3 inches wide by 1¼ inch thick and the panel B ½ inch thick.

It will be noticed that the top and bottom rails of the frame are rabbeted to receive the panel, but the sides are grooved, the groove in front rail being double the depth of the one in the back rail.

The dotted line, B, shows the size of the panel, the dotted line, C, shows the depth of groove in the front rail. From this it will be clear that the panel is only held in place at the back and front, and that on sliding it towards the front it will be free out of the groove in the back rail. Three sides of it are thus free, and a little manipulation will allow of it being taken out altogether, leaving plenty of space for the performer to get out, presuming him to have been locked inside the box.

If the panel were to be finished in this way, without further fittings, the secret would soon be discovered ; and I now proceed to show how the panel is held in place and firm while under examination.

Determine the size of screws that are to be used in fixing the brass corner clamps. Let us say No. 7 is decided on, and if brass screws are used, then get a piece of brass, Fig. 4, the exact diameter of the screw-head, and a little longer than the thickness of the framing. If iron screws are to be used then this piece must be iron. Now bore a hole into which this bolt will fit closely, right through the framing at D, Fig. 2. It is most important that the hole should be made close up to the edge of the panel, B, so that when the bolt is in, it firmly holds the panel, and prevents it moving from back to front in the grooving. Now get a piece of sheet brass, ⅛ inch thick, and cut it to the shape shown by E, Fig. 2. The width of this piece should not be less than ⅜ inch, and it must be of such length that the end reaches to the middle of the top framing, as shown at L, Fig. 2. This piece of brass is sunk in the top and front framing, as shown by the dotted lines, G, in Figs. 2 and 3 ; and also in section in the latter.

When the box is open, the lower or short arm of this lever, which is shaped as shown full size, at E, Fig. 8, is kept pressed down on the bolt, D, as shown by the dotted lines, E, E, E, Fig. 2, and E, Fig. 7, by means of the spring, J, Fig. 2.

On the box being closed, a pin on the under edge of lid goes into the hole, L, Fig. 3, and presses the end of the lever down in such a way as to raise the claw end of it from D. The thick dotted lines, F, F, F, Fig. 2, show position of lever when box is closed.

It will be noted that the bolt, D, Fig. 4, has a groove cut in it all round, into which the claw fits. This prevents the bolt being pushed backwards or forwards when the box is open.

The lever must be hung as shown, K, Fig. 2. The exact position of this is immaterial, but it is as well to have the fulcrum as near the end as may be, in order that the claw may be raised sufficiently with only a small movement of the short arm of the lever. Of course, the shorter this arm is, the more accurately the lid and pin must be made to close.

If the pin, pressing short arm down, be too short, the pressure will not be enough to release the claw, and consequently the performer might find himself really unable to get out of the box after it is locked.

The end of the lever should be finished with a wood block as Fig. 6, larger than the pin on the lid, as represented by L and M, Fig. 3.

The block may be of other material, but should be coloured the same as the wood the box is made of, so that if anyone were to look down on it no suspicion would be aroused as might be, were plain brass used.

In Fig. 5 I show an easy way of hanging the lever. It is simply a piece of wire sharpened and notched, so as to form several small barbs preventing withdrawal. The mode of fixing will be easily understood by reference to B and C, Fig. 5. Some considerable amount of care will have to be bestowed on fitting and adjusting this part of the work, on which the successful performance of the feat consists, and before finally fixing up, it should be ascertained that all the movements work harmoniously. It will be best to cut the groove in which the lever works from below, and after the lever is fixed to fill up the space not required by the lever, with strips of wood, H, H. If preferred, the space can be shaped out from the back, *i.e.*, the inside of the framing, and then filled where not required, but as this, however neatly done, would show a join which might be detected by sharp eyes, it is better to cut from below, though more troublesome.

The end containing the movable panel being arranged, make up the rest of box to it, taking care to make the rebates of top and bottom frames to correspond with those of the end.

The other panels should not however depend on the grooves on two sides only, but at tops and bottoms as well.

The rebates are to be cut only to have all the framing inside look alike; and as the panel, B, is made to fit quite close into the rebate, it will not be surmised that it is not fitted in the usual way.

After the box is made and fitted together, the clamping must be done. The only necessity for this is in order that the bolt, D, which we have seen is made on the outside end exactly to match the screws used to fasten the clamps, should not be conspicuous as it would be were it alone. As it is, it will not be specially observable, being apparently only one of the screws to fasten the clamps.

The clamps may be of thin brass or iron, shaped as shown at Fig. 9. One of the corner holes must be arranged to cover D exactly, and the others regulated to it. Let us suppose that A, Fig. 9, is the one through which the bolt goes, the other corner screw holes must be equally distant from the edges of clamps. Twelve of these clamps will be needed. After they have been screwed on, put the bolt through and let the claw of lever hold it in place. Then mark and cut the bolt flush with the clamp, making a hollow on the end of it to imitate the screws, as D′, Fig. 4. The other end of the bolt should be either made flush with the inside of frame and coloured to match it, or, better, cut short and faced flush with a piece of wood to match the framing.

If a piece of wood with a knot be chosen for this side of the frame, so much the better. Immediately over the hole, L, a wooden pin should be fixed in the lid, and of such length that it will press the short arm of lever down sufficiently. It should fit the hole pretty closely.

At the other end, a corresponding pin and hole should be made, and, say, two along the front. These will then look as if they were intended merely as fittings to hold lid in position. The lid at the other end of the box from the movable panel should have a stop of some sort, the ordinary brass joint stop will do as well as any, and should be strong. The reason for placing it at what I may call "the other end," is, that when the box is being examined, it will attract notice and draw attention from the movable panel end.

We may now finally adjust the loose panel, which must fit tight at top and bottom, and be slightly bevelled, as shown on section. Two holes must also be cut through it, at such a distance from each other that a finger and thumb can be put through them, so as to allow of the panel being moved. In the deep grooving in front, also put a couple of springs, say, pieces of clock springs, as shown I, I, Fig. 2. These serve to assist the bolt, D, by pushing the panel into position.

Holes to match those in end panel must also be cut in the other panels, and when a lock, preferably a padlock, has been fitted, the box is complete.

I don't know whether it is necessary to say that the lid should be hinged at the back, and of course it will add to the appearance of the box if it be polished or oiled.

Now for those who may not have seen the locked and corded box trick performed, a few words of caution may not be out of place. Don't forget to have something in a pocket easily got at, that will serve to push the bolt out, before going into the box. A piece of stout wire, a small pencil-case, or anything of that sort will do. Be careful when getting into the box to lie with your head towards the loose panel end, and face towards the front—as there will be no space to turn round—the right hand will then be uppermost, and free to push the bolt out. Having done this, grasp the panel with the finger and thumb by means of the two holes, push it to the front of the box, when the back edge will be clear of the groove. It can now easily be pulled into the box, and the performer can creep out. When out, refix panel and

bolt so that everything looks as it was. Any cording that may be over the end of the box will give sufficiently to allow of exit.

I have, I think, made it quite clear that padlock and ropes have nothing to do with the real performance of the trick, but they serve to mystify spectators who may be allowed to knot the rope and seal the knots in any way they choose.

There must always be a screen or curtain to hide the box from the spectators while the performer is getting in or out.

With the aid of this box various marvellous feats may be performed; for example, it may be used in connection with the sack trick, the performer before being put in the box being tied up in a sack. A tumbler of water may be put on the box, and the water drunk without the tumbler having apparently been moved, or the performer having left the box. Of course, to do this, he must get out of the box, drink the water, get in the box again, and fix the panel. In the same way various things left on top of the box, may be taken inside, or the reverse.

A very effective trick is for the performer to allow his coat to be tied up the front, before going into the box, and then getting out of it, minus his waistcoat, which, on the box being unlocked and uncorded will be found neatly folded up inside it.

It is, however, I imagine, hardly within the scope of this magazine to explain conjuring tricks further than their construction; and for those who want instruction in performance, I have sent to the Editor the address of the professor of conjuring already referred to, who, I have no doubt, for a consideration, will be happy to explain any of his tricks.

In future articles I hope to explain how to make various other pieces of apparatus useful for conjuring purposes.

HANDY WORK IN FARM AND GARDEN.

By GEORGE EDWINSON.

X.—DITCHING AND DRAINING.

THE art of draining farms and gardens, for the purpose of making the soil more productive, may be deemed a modern art, for although its importance has been well known during many centuries to the inhabitants of low fenny and marsh lands, and has been practised on such lands, the practice of the art has not extended to those lands containing only a small portion of marsh or fen. The holders or owners of such mixed lands were well content to leave them with their natural drainage, and to use the wet portions as summer pasturage, because they were either ignorant of the fact that such wet land could be improved by drainage, or were too poor or ignorant to get the land properly drained. It happened, therefore, and it happens still in many localities, that a large portion of wet land remains undrained, and, as a consequence, unproductive, because the owner or holder thinks it would cost a large sum of money to drain it in a proper manner. There are others, even in these enlightened days, who view the matter with indifference, and when spoken to on the subject, are not sure that the land would be improved by drainage. If we could give such persons examples of the effects produced by drainage, and show them that the results would repay handsomely the cost of labour, we should probably win them over to adopt some system of drainage, but how are we to do this? I hope to show in this article, and one to follow it, how to cheaply and effectively drain such small patches of wet land, and also to give some good reasons for doing it.

First, as to the reasons for draining wet patches of land. If any of my readers have been troubled with wet patches in their gardens, they will know that it is next to impossible to grow a good crop of potatoes, carrots, parsnips, onions, or any root crop in the wet patches. Even in the hottest and driest summers the roots will be small, and the soil will enclose them like baked dough. The soil is always heavy and sticky, and, in addition to this defect, it is deficient in root-feeding material. Manure put into this soil remains in its original condition too long to be of any service to roots; for, unless air can get into the manure, it will not break up into those soluble substances which feed roots and cause growth in vegetables. More than half of the heat received by this soil from the sun's rays is absorbed in the work of converting the extra water into steam, and thus the vegetables are robbed of the heat which should assist in promoting their growth. To give one illustration alone of wasted sun energy on such lands, I may point out that no less than 3700 tons of water fall on an acre of land on an average in the course of a year, and if this is allowed to remain in the soil it will absorb enough summer heat to equal that derived from the combustion of 550 tons of coal, to convert the water into vapour and render the land fit for tillage. If the land is properly drained, this water passes slowly down through the soil to the drains, and in its passage carries atmospheric oxygen, ammonia, and nitric acid to the subsoil, which is by these agents broken up into soluble food for plants. The same reasons for drainage apply equally to farm and garden, for there are few crops that will thrive in wet undrained fields, and all, even oats and rape, thrive best when the land is drained.

Natural Drainage.—The Creator has arranged

some lands in a manner peculiarly fitted for man's occupation, whilst others require his aid before they can be occupied by him. Land arranged in rounded hills and shallow valleys is furnished with a natural system of drainage in the form of rivers communicating with lake or sea, rivulets communicating with the trunk streams, and other small streams intersecting the whole country, a map of the whole system appearing like a tree with branches spreading over all the land. This system of drainage should be imitated by man, who should unite the main or trunk drains of his system with those of the natural system, or construct canals to form open main drains from lakes to large tracts of land.

Open Drains.—The drainage of large tracts of low country by means of lakes, canals, and ditches, is a public work to be carried out by governments, corporations, and local boards. Examples of such large undertakings are seen in Holland and in the fen districts of Lincolnshire and Cambridgeshire, where lakes receive the water drained from the surrounding country, and pumping engines or scoop-wheels lift the lake water into raised artificial rivers, by which it is conveyed to the sea. With such gigantic engineering works we have nothing to do in this series of papers ; but small tracts of flat land near some natural drain or reservoir may be drained and improved by a system of ditches, water courses, and open drains. If the land is subject to flooding from the sea or from a tidal river, it will be necessary to build a dyke or sea-wall to keep back high tides before the work of ditching and draining can be attempted. Dykes or embankments are merely high and broad hedges constructed in a special manner of various materials, such as stone and earth, turf and clay, wood piles with a filling of earth, or a wall of masonry. If the volume of water to be resisted is moderately large, say, for instance, a 5 feet rise of tide from a river, the base of the dyke should not be less than 20 feet in width, and the foundation should be sunk below low water mark if the structure is to be of stone, or the piles should be driven into the mud to find a firm bottom if piles are used to face the dyke. Large heavy stones must be used in constructing the river-face of a dyke, and these should be built at a uniform angle or slope of 30°, filling up the hollows between the stones with puddled earth or clay as the dyke is built. Puddled earth is composed of fine soil made into a thick mud when in position between the two shells of stone, by pouring water on it and stirring it with poles. Clay is sometimes used for the purpose, and is preferred by engineers when obtainable, when it is similarly treated. A filling thus prepared will resist percolation of water, and make a firm waterproof embankment. The river-faces of embankments or dykes are frequently composed wholly of wooden piles, sometimes squared to a section of 5 inches and shod with iron, but often employed in a rough state with some of the bark on, having been merely roughly trimmed with the axe. These must be pointed at one end and bound with hoop iron, as shown, Fig. 114, and driven well into the bed of the marsh by means of a pile-driving machine erected on a stage. Some idea of the machine required may be obtained by referring to p. 405, Vol. IV. The filling between the two rows of piles should be rubble or rough stones next the piles, with a centre filling of puddled earth or clay. The inclination of the face of the piles need not be more than that shown in Fig. 115, if the piles are driven well into the soil, and the space at the base between the two rows of piles need not exceed 12 feet, if piles are used on both sides of the dyke. It will be understood, of course, that I refer only to small tracts of marsh land with only a few hundred feet face to a moderate tideway, such as that illustrated in the annexed maps (Figs. 127, 128). Larger tracts, exposed to the scour of a swift high tide, should not be attempted by persons of moderate means, nor should the reclamation of land exposed to the stormy waves of the sea be undertaken by amateurs without the direction of an engineer. If, however, any of my readers wish to engage in works of a larger magnitude than those herein indicated, I shall be pleased to hear from them and will advise them through the columns of "Amateurs in Council."

At the lowest level of the marsh an opening must be left in the embankment to allow the land waters to pass away, and this opening must be protected by a sluice valve to keep back the tide. It may be necessary to provide more than one such opening at two different parts of the embankment, the necessity being dependent upon the conformation of the marsh, its opening to the natural water-way, and the volume of land water to be taken away in wet seasons. Whilst the work of constructing the embankment is proceeding, a wide opening should be left for the incoming and outgoing of the tide, and this opening filled up when the valve has been fitted in position after the rest of the dyke has been completed. The mouth of such an opening, and also its sides, should be protected with piles to prevent sapping of the foundation. The self-acting sluice valve required at the outfall is shown at Fig. 116, and is constructed as follows :—A strong wrought-iron frame, fitted with stout hinges, as shown at Fig. 117, is first made, and this is filled up with elm plank 2 inches in thickness fitted closely together, another similar thickness of elm plank is firmly bolted across the first to the iron frame, and the edges of the two thicknesses are bevelled as shown by the dotted lines in Fig. 118.

The flap, thus constructed, is hinged to a stout wooden frame, built into the mouth of the culvert, or firmly bolted to it, if the culvert is made of wood. The size of the culvert and the dimensions of the sluice valve must depend upon the volume of water to be passed through it at low tide from the land side, and this can be ascertained by noting the volume passing through the openings left for the purpose before the culvert is built, but an allowance must be made for an increase in volume in wet seasons; the smallest, to be of any service, should not be less than 2 feet by 1½ feet.

In small undertakings I have known, the culvert has been constructed of 2-inch elm plank fitted with sluice valve entire, as shown, Fig. 119; such a culvert is put together on the embankment and lowered into its future position at low tide when the rest of the work is nearly completed. The river side of the opening is then rapidly built up with elm planks nailed to the inside of the piles, and the land side in a similar manner, and the intervening space rapidly filled up with rubble and puddled clay. In this way the whole work may be expeditiously and cheaply performed.

Culverts made of elm will last for several generations, but cannot be considered to be permanently durable. In works of a permanent character, therefore, the culverts should be built of stone or brick, and this necessitates the construction of a caisson or watertight compartment alongside the opening and extending beyond it at each end, in which the masons can work without fear of interruption by inrushing water. Caissons for this purpose are formed by first driving a number of sheet piles close together around the space to be enclosed, nailing an inner skin of planking to these and filling up the space with puddled clay as shown, Fig. 120. In such a caisson the workmen can work comfortably, and the piles can be withdrawn by means of a chain and crab winch when the culvert has been completed. Sheet piles are made of planks pointed and shod with iron, as shown, Fig. 121. The foundation of the culvert should be laid on a bed of concrete 18 inches in thickness at least, and sunk below the low water level. On this may be built two walls of masonry spanned by a covering of stone slabs, if the culvert is to be a small one, but a regularly built barrel culvert of stone or brick, as shown, Fig. 122, should be constructed if the volume of land water is large. The mouths of the culvert should project beyond the sides of the embankment, and the riverside mouth must be guarded with a solid wall of masonry, in which the frame of the sluice valve must be built at an inclination corresponding with that of the piles, as shown at Fig. 115, to ensure the closure of the flap against the returning tide.

The inside part of the embankment on each side of the culvert mouth may be of earth only, be made to slope gently down to the surface of the marsh, and be covered with turf or sown with grass seeds. A small portion of the marsh inside the mouth of the culvert should be excavated to form a pond or lake, and the main drainage canal or ditch must run from this lake along through the marsh. This canal should run through the lowest part of the land to be drained, but it is not necessary to follow the natural windings of the water courses. The width and depth of the canal must be determined by local circumstances relating to the volume of water to be drained away in the wettest season of the year and the length of the drains. A canal, 5 feet wide by 2½ feet in depth, may be suggested as likely to meet the demands of such small undertakings as those already indicated.

The mud and soil excavated from the bed of the canal should be thrown up on each side to form the banks, the general conformation of which is shown at Fig. 123. If there is much sand or loose mud, it may be necessary to protect the banks from water erosion, and this can be done by driving in a row of stakes or small piles along by the side of the excavation, backing these with brushwood laid transversely, and filling up with the friable or loose excavated material. The same precaution may be necessary in constructing the ditches or small branch canals. These should be run across the marsh from the main canal, at distances of about 300 yards. They should not be less than 3 feet wide at their junction with the canal, but may be gradually contracted and shallowed as they reach their opposite ends.

The spaces intervening between the ditches should now be formed into beds or plots by running furrows across each space from ditch to ditch at intervals of five yards. Those furrows should be about a foot in depth and width, and the mud excavated from them should be thrown on the plots on each side. The whole reclaimed space may now be left to drain and dry, and thus get into a fit condition to be broken up for cultivation.

I have gone more thoroughly into this subject of reclaiming marsh land from the sea and tide than I first intended, my intention at the outset being to show my readers that it is necessary (before attempting to drain a piece of land) to provide a means for the released water to escape, and it would be manifestly useless to construct a system of drains on land near or contiguous to a marsh, unless the marsh itself was first drained, for the back water from the marsh would flow into the drains and choke them.

Having provided a way for the water to escape, or

having carefully made sure that the water can get away from our land without injuring the landed interests of our neighbours, we may set about draining every acre of our holding. If the soil itself is free—that is, if it is composed of sand and sandy loam with a small admixture of clay, and only suffers from being in a low flat country—we may, perhaps, be able to drain the whole by means of ditches and open furrows communicating with the main drainage system. In such cases as these it will be necessary to make the ditches act as fences or part fences to the fields. By the latter term is meant those composite fences composed of a turf bank thrown up in making a ditch, the bank itself being planted with dwarf bushes, and the ditch used for an open drain. Roadways to such fields are made to cross the ditches by means of wooden bridges composed of logs thrown across the ditches, and resting on piles firmly driven into the soil. To complete the drainage system, the fields should be laid up in beds or ridges, and these may be formed with a plough in the following manner:—A straight furrow is driven from side to side of the field with a single breast plough, and the earth from the next furrow is thrown up against that of the first. Other furrows are then made around the central guiding furrow, until twelve or twenty-four furrows have been added—that is, six or twelve on each side. Another plot of ground is then marked out, and another twelve or twenty-four furrowed ridge is formed. In this way the whole field is made into beds, with a deep wide furrow between each, and this furrow is made to extend, by means of hand labour, into the ditches at each end. This conformation is carefully maintained during the whole time whilst the field is in cultivation, and is retained when the land is laid down to grass. By these simple means alone much may be done to drain wet fields.

FIG. 127.—MAP SHOWING WET LAND FLOODED AT HIGH TIDE FROM TIDAL RIVER.
The dotted lines show channel of river and creek at low tide. A, Wet land requiring drainage.

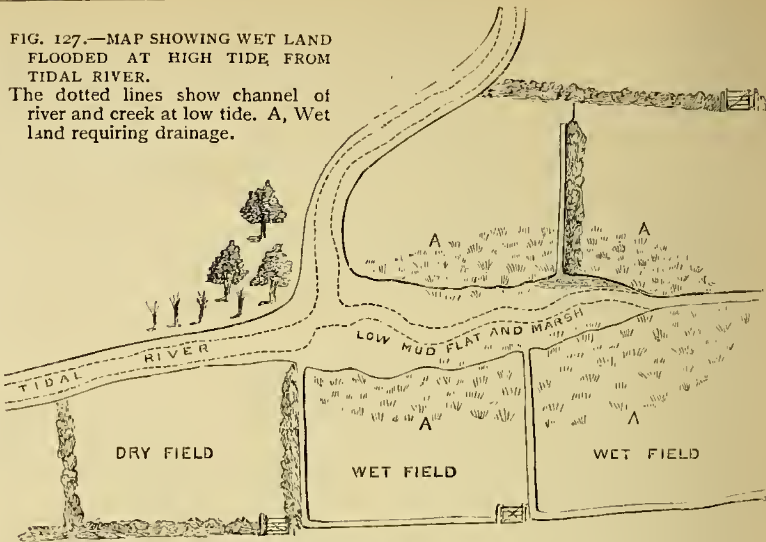



FIG 124


FIG 125

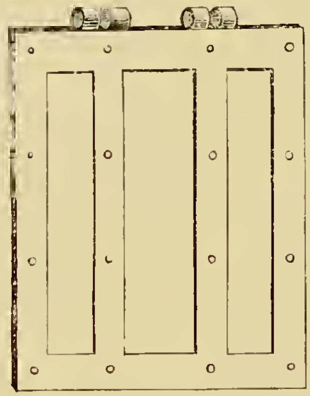
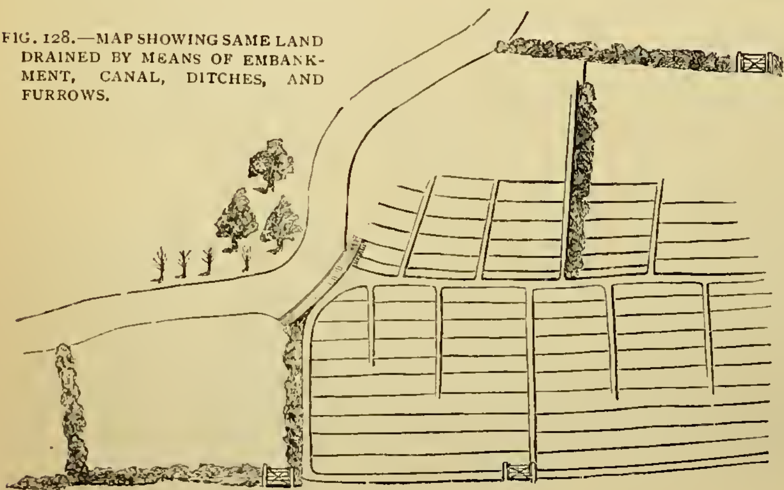


FIG 117


FIG 118

FIG. 128.—MAP SHOWING SAME LAND DRAINED BY MEANS OF EMBANKMENT, CANAL, DITCHES, AND FURROWS.



Brushwood Drains. — The first departure from simple open drains to those of a more elaborate and expensive description may be classed under this heading. It happens sometimes that a field has an obstinate wet clay patch on one side, or in one corner, which will not yield its water to open drains. In

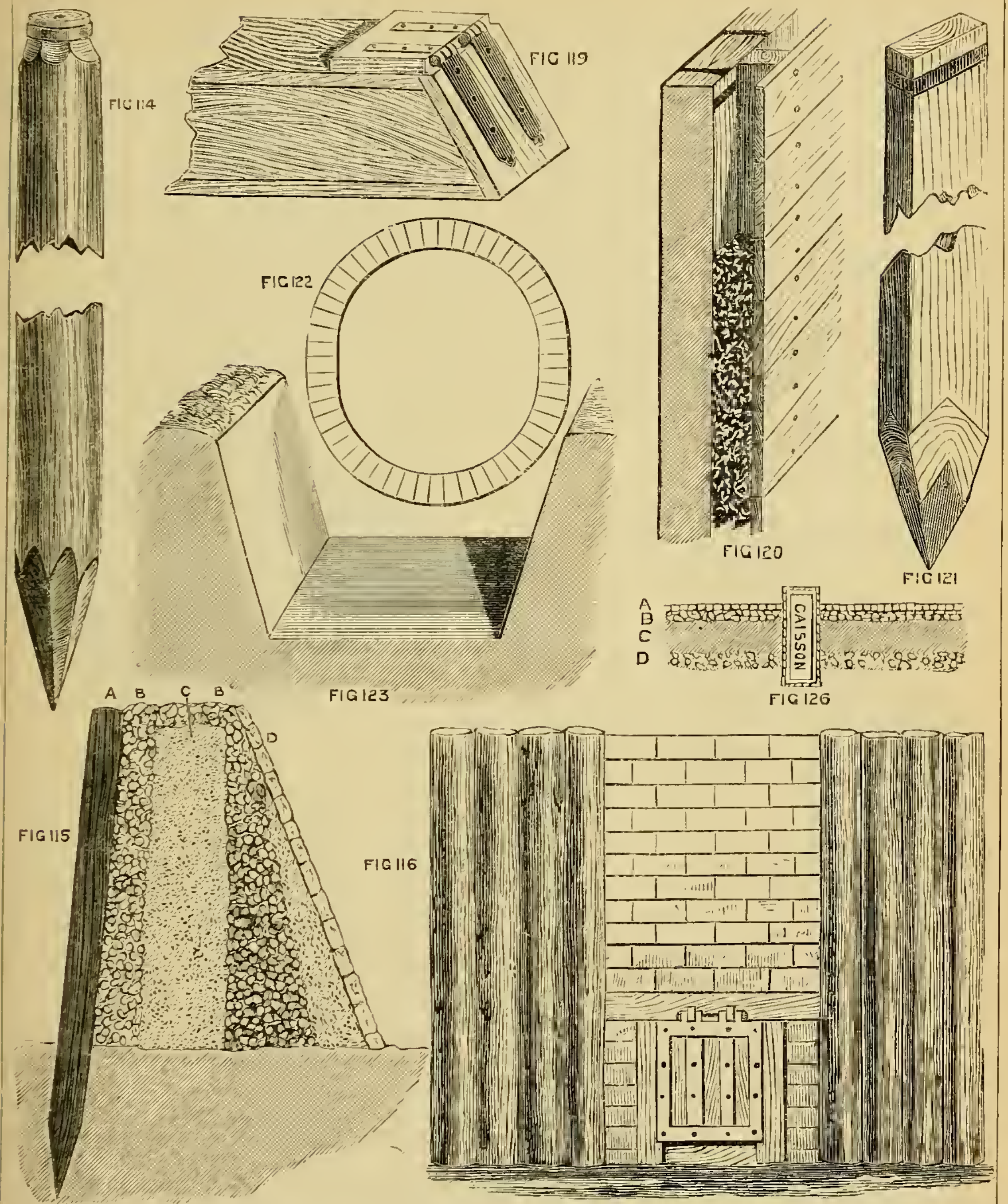


FIG. 114.—ROUND PILE. FIG. 115.—SECTION THROUGH EMBANKMENT.—A, Piles; B, Rubble; C, Clay; D, Earth. FIG. 116.—FRONT ELEVATION OF EMBANKMENT SHOWING SLUICE VALVE AT MOUTH OF CULVERT. FIG. 117.—IRON FRAME FOR SLUICE VALVE. FIG. 118.—SECTION OF SLUICE VALVE. FIG. 119.—ELM CULVERT AND SLUICE VALVE. FIG. 120.—SECTION OF CAISSON WALL. FIG. 121.—SHEET PILE. FIG. 122.—SECTION OF BARREL DRAIN OR CULVERT. FIG. 123.—SECTION THROUGH CANAL SHOWING INCLINATION OF BANKS. FIG. 124.—BOLT FOR HINGE OF SLUICE VALVE. FIG. 125.—EYE-BOLT FOR HINGE OF SLUICE VALVE. FIG. 126.—PLAN OF EMBANKMENT.—A, Piles; B, Rubble and Clay; C, Puddled Clay; D, Earth and Stone.

such cases we must tap the source of the water lower down and convey the surplus to the ditches by means of deeper drains than those of simple furrows. The wet land should be intersected with trenches, 2 feet in depth by 18 inches in width, communicating with the ditches. If these are full of water, a dam of piles and puddled clay must be erected across the mouth of the trench whilst in course of construction. When the trenches have been dug along the course of the ordinary centre furrows, a quantity of brushwood should be cast into the bottom of each trench to the thickness of from 6 to 9 inches. The best wood for this purpose is elm and alder, in brush or long poles laid lengthwise. If there are any spar or flint or other stones available, cast these on the brushwood, and fill up the trenches with the soil taken out from them. Then withdraw the piles from the dam and leave the drain open to the ditch.

(*To be continued.*)

NOTES ON NOVELTIES.

By THE EDITOR.

1. WARMAN'S "THE ORGAN: ITS COMPASS, TABLATURE, ETC." 2. APPLEGARTH'S CORRUGATED CARBON PLATES. 3. SYER'S UNIVERSAL MITRE CRAMP. 4. MESSRS. HARGER BROS.' NEW CATALOGUE, ETC.

1. THIS is the first instalment of a work, which, when completed, gives promise of being one of considerable importance and great interest to Organ builders. To give its title in full, the book under notice is "The Organ: Its Compass, Tablature, and Short and Incomplete Octaves." By John W. Warman, A.C.O., Late Organist of the Anglican Cathedral, Quebec, Author of "A Condensation of the Primary Laws of Counterpoint." It is published by Mr. William Reeves, 185, *Fleet Street*, *London*, *E.C.*, at 3s. 6d. in paper wrapper, and at 4s. 6d. boards, with cloth back. It contains 160 pages, 10 in. by 6⅝ in., and is well printed in large type, with a wide and handsome margin such as all books of this kind ought to have to receive the notes and jottings which a reader may wish to make. The purpose of the author may be best understood from the commencement of the preface, in which he explains that the book as it stands "constitutes the first *written* of a Series of *Departments* which are designed to form collectively, a COMPREHENSIVE TREATISE on the *Construction*, *etc.*, of the *Organ*." Further, it is to a certain extent, put forth in refutation of the views held by Mr. Hopkins with reference to the GG compass. After defining the terms "Compass" and "Tablature," with reference to diagrams of the Tablature with Notation and the Old Italian Incomplete Octave, he proceeds to give a long list of instances of organ compass, in a large number of organs, old and new, showing in separate columns their upward and downward range, locations, dates of sections, makers concerned, total number of manual claviers in the organ, a specification of the manual or manuals to which the given compass relates, and dates of repairs, reconstruction, additions, etc. This table in itself, occupying thirty-seven pages, is most interesting. The author then continues with remarks on the construction of various organs, for which the curious reader must be referred to the work itself.

2. *Applegarth's Corrugated Carbon Plates.*—All users of electric batteries, in which carbon plates form the negative element, know that the strength of the electric current rapidly falls when the battery is set to work. This is said to be due to a film of hydrogen which covers the plate and protects it from action by the solution. If the surface of the plate is made rough with a file, the hydrogen does not spread over the plate as a film, but is thrown off from the roughened surface in bubbles. Cutting carbon with a file, is, however, a hard and dirty job, and our readers will be glad to know that carbon plates for batteries, already roughened, can now be obtained at rates nearly as low as those for plain plates. The manufacture of corrugated carbon plates is carried on by Mr. R. Applegarth, the Inventor and Patentee, at the *Atlas Carbon Works*, *Ewer Street*, *Southwark*. These plates are not cut, but are moulded to form, and baked. The corrugations are, therefore, regular, and run longitudinally from top to bottom of the plates, which are made in three sizes, 5, 6, and 7 inches in length, and are sold capped or uncapped as required. Mr. Applegarth is also the inventor and patentee of a most compact *multum in parvo* Electric Bell, Battery, Line, and Pressel complete, in a polished ebonised case. The dome of the bell, 3½ inches in diameter, covers all the movements, which are thereby concealed under a metal cover, and this is attached to the small box containing the battery. This, in itself, is a unique invention, consisting solely of a carbon cell corrugated internally, and fitted with a cover from which hangs a zinc rod. There is no porous cell, no glass or earthenware to be broken, and the exciting solution is composed of sal ammoniac dissolved in water. The Léclanché cell is thereby superseded, for the Applegarth carbon cell is practically everlasting, and only needs cleaning and re-charging once every six months or so. The inventor has also patented a novel combination of induction coils for medical purposes, to be worked with current from his battery. This most powerful combination, with a 20-cell battery, is contained in an elegant polished walnut case one foot square! It is the most simple, cleanly, and portable medical coil and battery ever invented. Mr. Edwinson has had the opportunity of examining and testing the quality of Mr. Applegarth's goods, and is prepared to recommend them to the readers of AMATEUR WORK. Those of our readers who may wish to see a sample corrugated carbon plate, may have a 5-inch plate sent by post for 6d., by enclosing six stamps with address (*under cover* to Editor), to Mr. George Edwinson, with the words "*Corrugated Carbon Plate*" in lower left hand corner of envelope.

3. *Syer's Universal Mitre Cramp.*—Amateur picture-frame makers will welcome the new Universal Mitre Cramp, recently introduced by the patentee and maker, Mr. Thomas J. Syer, 1, *Finsbury Street*, *Chiswell Street*, *London*, *E.C.*

Its construction and the manner in which it is used will be apparent from the illustration of the appliance that is given in Fig. 1, from which it will be seen that it cannot fail to secure truly any mitred joint whose surfaces are bevelled at an angle of 45°. The price, complete, mounted on board, is 21s. The advantages that it possesses over the old form of cramp are numerous, and may be particularised as follows:—Firstly, it will securely cramp any moulding from ½ inch wide up to 5 inches, which at once obviates the necessity of having three or four sizes of cramps for various widths; secondly, the teeth upon the centre plate first press against the rebate and afterwards push the moulding forward and so close the joint; thirdly, being faced inside with wood, the machine cannot in any way cause injury to the moulding; and, lastly, it can be secured to any bench or table by G clamps, or hand screws. To use the appliance, it should first be secured to the bench or table. Then, having prepared the ends of the pieces of moulding that are to be

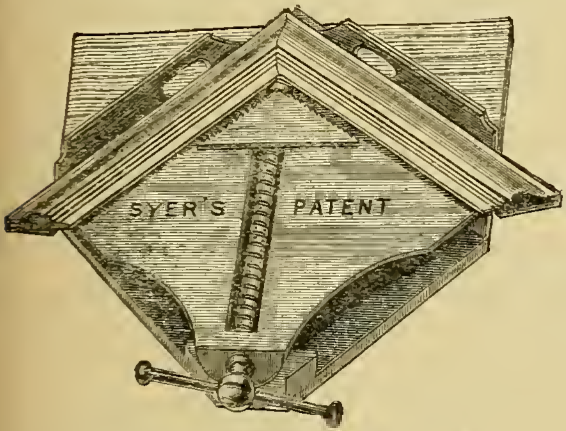


FIG. 1.—SYER'S UNIVERSAL MITRE CRAMP.

joined, place the two that are to be first connected in the cramp, and press them close at the mitre. This having been done, turn the handle of the screw to the right, which will cause the movable plate to be pushed forward until it presses firmly against the moulding, when the joint may be nailed or keyed as desired. The joints of the second, third, and fourth corners of the frame may then be made in the same way. Mr. Syer has had this mitre cramp in hand for nearly two years, but has refrained from bringing his invention before the public until he had, by repeated experiment and trial, caused it to assume its present perfect form.

4. *Messrs. Harger Bros.' New Catalogue.* — Messrs. Harger Brothers, who, to call them what they call themselves, are "Importers and Dealers in Fret Materials and Publishers of Fret Patterns," *Settle, Yorkshire,* send the latest edition of their "Catalogue of Machines, Designs, Tools, etc., to which they wish me to call special attention," as "being useful for fret workers, being the most complete of any published." That it is a sixpennyworth likely to be eminently useful to fretworkers and to amateurs in general, I can bear testimony without compunction or prickings of conscience; but I cannot declare either on oath or affirmation—I have no objection whatever to either process, but I infinitely prefer the former—that it is the most complete of its kind, seeing that I am not in possession of all others of its kind wherewith to compare it, before I take upon myself the always dangerous task of indulging in superlatives in matters of assertion. At all events, I can say that it is a catalogue which serves as a finger-post to show amateurs where they may buy many articles, tools, materials, and fittings, that they are frequently in want of, but are as often puzzled where to go to get them; and that for this very reason it is a catalogue that I myself am glad to have within my reach. For example, it is useful to know, or to be reminded, that silvered mirrors of any size or shape, with or without bevelled edges, are supplied by Messrs. Harger Brothers, and to have a list of the sizes and prices of those which are always kept in stock. Further, they wish me to call attention to the "Walking Beam Saw" which I have much pleasure in doing, as I have already seen this excellent machine at Messrs. Churchill and Co.'s, and intend to call attention to its construction in the pages of this Magazine at the first convenient opportunity. And they desire to have particular mention of their "furniture series of designs," as being "superior in appearance and finish," and "enclose one full size design of the 514 Overmantel from which you will see that they are correctly drawn, and printed equal to any published. We wish this to be known, as we have noticed articles in AMATEUR WORK intimating that the German designs were superior in finish to any others in the market. We have," continued Messrs. Harger Brothers, "the German designs, but they are most intricate, and few can make anything of them." Well, with regard to the drawing and printing, if by this is meant clearness and evenness of outline and uniformity of tint, the "514 Overmantel" is doubtless equal to any published, but in point of design it is far inferior to the German productions which have been noticed by me from time to time. It certainly does not err in *intricacy* of design, and is far from being one which I myself should choose if I felt an inclination to indulge in decorative furniture of this character. But, luckily, tastes differ, and we all know that what is one man's meat is another man's poison.

If anyone wants a piece of "decorative furniture" in the shape—I may say, *quasi* shape—of a church, he will find patterns, details, and instructions for this "elegant piece of work," and "work of art," in which "provision is made in the front of steeple for the insertion of a clock," in Design 305 B, price 2s. 6d. The church, when made, assumes the dimensions of 17 inches by 19 inches by 23 inches, which is somewhat large and inconvenient for a clock stand. I do not know who may have been the architect, but I cannot repress a smile when it occurs to me that this is the sort of thing that Messrs. Harger Brothers look upon as being equal in every respect to the German designs, which, in my want of taste and weakness of judgment, I still infinitely prefer.

At this point, unfortunately, want of space compels me to stop, so I must defer until next month my notice of the New Catalogue issued by Messrs. Charles Churchill & Co., 21, *Cross Street, Finsbury,* and some excellent German designs for Fretwork from Mr. Henry Zilles, to which I shall have much pleasure in calling special attention.

AMATEURS IN COUNCIL.

1. *Contributors to* Amateur Work *and Correspondents asking or answering Questions in "Amateurs in Council," are requested to write on one side of the paper only.*

2. *When Illustrations or Diagrams are necessary, draw them on a separate piece of paper, because the "copy," as the manuscript is technically called, has to go to the printer, and the illustrations to the engraver.*

3. *Abstain from the epistolary form, as it is utterly unnecessary, unless in letters of business. Put the question you wish to ask, or the reply you wish to make, as briefly as possible, and write every separate question and every separate reply on separate pieces of paper. Sign each with initials, nom-de-plume, or name and address, as preferred.*

4. *Let every paper be headed* Amateur Work, *and follow these words with* "Information Sought," *when it is a query;* "Information Supplied," *when it is an answer to a query; and* "Sale, Purchase, and Exchange," *when it concerns anything to buy, sell, or barter.*

5. *It must be fully understood that no attention will be paid to any letter or communication in which these rules are not rigidly observed.*

[The Editor reserves to himself the right of refusing a reply to any question that may be frivolous or inappropriate, or devoid of general interest. Correspondents are requested to bear in mind that their queries will be answered only in the pages of the Magazine, the information sought being supplied for the benefit of its readers generally as well as for those who have a special interest in obtaining it. In no case can any reply be sent by post.]

Veneers: Where to Buy Them.

*** Amateurs in want of veneers for any purpose are informed that they may be obtained of Mr. A. Souhami, Importer of Walnut Veneer and Mahogany Merchant, 321, *Old Street*, and 45, *Hoxton Square, London*, E.C., and at Salaman's Veneer Depôt, 162, *Shoreditch, London, E.C.* The thanks of the Editor are due to the gentleman who left for him, at Warwick House, cards conveying the above intimation.

G. H. H. (*Canterbury*) also writes on this subject:—"Allow me to recommend buyers of veneers and all other fancy wood to give Messrs. D. Witt and Palmer, 1, *Upper Rathbone Place, Oxford Street, W.*, a trial; they are civil and obliging, and their goods are cheap and of the finest quality."

Electric Light Installations.

Messrs. Heindorff and Co., *Albert Street, Brisbane, Queensland*, write a long letter in which they say that the articles on "Electrical Apparatus" in Amateur Work have proved of great interest and material assistance to them. In that "out-of-the-way corner of the globe," "far away from the centres of civilization," they are not always well informed of the latest discoveries, and they wish to know whether the electric light has been sufficiently perfected, or not, to be successfully used on a small scale in lighting up "a few rooms in private dwelling houses, jeweller's shops, store windows, etc.," at a not too expensive rate. They have learned hitherto that "electric lighting on a small scale has been as good as a failure on account of the expense." Messrs. Heindorff and Co. are importers of electric goods from the Continent, and they appear to be well informed on this subject. The least costly method of working such small installations of electric light for short periods, is that wherein the current is supplied from accumulators charged by a dynamo machine, driven by steam or water power. Small temporary installations of electric light are made here in England, by contract, in the following manner: A dealer in electric goods or a manufacturer of electric light requisites, undertakes to light up a shop, a bazaar, or a mansion, for a few nights only. He sends his men to "wire" the building and fix the lamps; then he sends the necessary accumulators charged ready for use, and by means of these, supplies the necessary current for the stipulated period. As he has always an abundance of spare steam power at hand, and dynamo machines on the premises as part of his stock in trade, it costs him little to charge the accumulators, and he can thus lend the small plant at a cost far less than that of an installation, with current supplied by primary batteries. But accumulators are costly apparatus, and there is always a risk of breakage of lamps; these risks and costs must be covered by a percentage in the charge for hire, in addition to the price of labour and profits on the contract. The expense to the user is therefore necessarily high, and the primary cost or first outlay on plant necessary to maintain such installations, is also sufficiently high to prevent amateurs from making their own accumulators, machines, and other apparatus for this purpose. Several inventions for cheapening the supply of small electric light installations have been recently introduced, but I have not had the opportunity of testing their value. If their inventors will communicate with Messrs. Heindorff and Co., these gentlemen will be glad to correspond with them, and they farther invite communications from all English manufacturers of electric goods.—G. E.

Lens for Camera Obscura.

B. A. (*Bristol*).—The successful working of a camera obscura depends on the right adjustment of the ground glass with regard to the focal laying of the lens used. The focal length of a lens does not depend on its *diameter*, but on its convexity, *i.e.*, species and thickness of *curvature*. These data B. A. does not give. If the querist will kindly mention to us the thickness through (ganged with a pair of callipers) of the lens, and its diameter, together with the information as to whether the lens is a double convex one, a plano-convex one, or a meniscus, he has used, we will be able to tell whence he is non-successful in the making of his camera, and advise him how to succeed. The article on the Camera Obscura in Part 37, December, 1884, gives all necessary information on this point.—H. C. S.

Spencer's Instantaneous Polish.

T. B. T. (*Carnew*).—Mr. Spencer makes and *sells* his polish. It is therefore most unlikely that he would care to give any individual subscriber to Amateur Work, or its readers collectively, "a list of the ingredients with their quantities that he uses in making 'Instantaneous-Polish.'" Such suicidal generosity on his part would be "killing the goose" with a vengeance. Nor will I ask "any kind reader of Amateur Work to give a subscriber a good receipt for making gentlemen's cuffs and collars." Further, I cannot spare space for thanking contributors for information supplied. It is assumed and taken for granted that recipients are grateful.

Osiers and Basket Making.

Εκβολινος writing from *Porongos, Uruguay*, refers to a promise of mine, made in Vol. I., p. 94, to give some instructions on Basket Making and the Culture of the Osier. My promises are always made provisionally, but I always do my level best, as the Americans say, to redeem them. There are two kinds of Salix or Willow, to which the name of Osier is given. These are, the common osier (*Salix viminalis*) and the osier (*Salix rubra*), so called, I presume, from the red, almost fiery hue of its bark in autumn. Either of these are suitable for basket making. The seed of the common osier may be obtained of Messrs. Viccars Collyer and Co., *Central Hall, Leicester*, at 10d. per oz., or 6s. 6d. per lb. This firm, by the way, supplies good and reliable seed of most forest trees, a fact useful for Colonists to know. With regard to instructions on Basket Making, I have not forgotten my promise; the difficulty is to find some one who can and will write on the subject. When this has been effected, a series of papers on Basket Making and all that pertains to it shall soon follow. Enquiries are always welcomed, especially from the Colonies and abroad, so no apologies are necessary for any amount of questions you like to put. I wish to be as useful as I can *in* and *to* my generation.

Washing Machine.

Roselea.—Your letter on this subject has been forwarded to Olla Podrida, with a request that he will take the matter into consideration, and think out a machine that any wood-working amateur may be able to make. This he has consented to do.

Doll's House.

Tempus.—At present the demands on my time are so many and so various, that I am unable to give the alternative design for the doll's house mentioned in Part 21. I will not lose sight of this, or of toy making, generally speaking.

Compound Condensing Engine, etc.

S. M. L. (*Goderich, Canada*).—For your engine a boiler 15 inches high and 8 inches in diameter, made of $\frac{1}{16}$ sheet copper, would do. You may, if you like, make it 16 or 17 inches high, the larger the better, and less trouble in getting an adequate supply of steam. The same boiler, if of good size, may also drive two or more models simultaneously. Such a boiler well made, with good stays and a couple of cross tubes, would carry 50 lbs. on the square inch. With regard to pumps, you may work them all, air pump included, from eccentrics, it is merely a matter of convenience if the proper cubical capacity of the pump is maintained. Your $\frac{3}{16}$ feed pump will do for table engine, if you make it one-fourth the stroke of engine, viz., half-inch stroke. Shall be happy to give further information if required.—Olla Podrida.

Amateur Work: Its Nature, etc.

E. D. (*Deptford*).—I am sorry you are disappointed with the new programme for Vol. V. I do not cater for lady workers. There are plenty of magazines devoted to their wants and interests, and Amateur Work is essentially a man's magazine, written by men for men. Do you know the story of Hercules and Omphale? If not, you will find it in Lempriere, and you can deduce the moral that I would seek to inculcate by referring to it.

The "Shipman" Engines.

Mr. G. Busschots, in accordance with his promise made in Vol. IV., page 550, to write further in answer to Westwood's inquiry respecting these engines, sends the following letter, received by him from the "Shipman" Engine Company:—

"*Liverpool.*

"Mr. G. Busschots,

"To yours of the 25th. Those engines are so cheap that they produce trouble. The purchaser buying them at toy prices and expecting them to be durable and equal to business. We can send you half a dozen of them at the old price, cash down, but we do not advertise them any longer, and shall not make them. Indeed, the whole engine has been greatly changed, and the new modelled machine gives great satisfaction, and we are confident that no engine has ever been put out that equals it in this particular. Every purchaser is its friend, we can send you now the new engines.—Yours respectfully,

"The 'Shipman' Engine Company."

[Messrs. Churchill and Co. gave me similar information when I last saw them. The Company, not satisfied with the engines as originally sent out, have been doing their best to improve them and make them as good as possible. While making their experiments they found it was not possible to send out the improved engine at the prices originally named, and hence, without doubt, has arisen the variation in price, as given in the different circulars to which reference has been made.—Ed.]

Astronomical Telescope.

E. D. (*New Quay*).—To form an astronomical telescope with a lens of 6 feet focus, it should be mounted in one end of a tube, slightly larger in diameter than the lens, and 6 feet long. At the other end, a short sliding tube should be placed to carry the eyepiece and allow any variation of distance between eyepiece and object glass, which may be necessary to secure distinct vision. If the querist will state the exact diameter, focal length, and description of the lens he has, I will direct him how to mount it simply. At present, I am afraid he knows nothing about the subject. Is it an achromatic lens? If not, it will scarcely repay the trouble of mounting.—E. A. F.

Water Telescope.

E. D. (*New Quay*).—A water telescope is not a telescope at all in the ordinary sense, but merely a tube of any convenient diameter and length, open at one end and made watertight at the other by being glazed with a piece of ordinary window glass. The glazed end is put beneath the surface of the lake or pond, and the eye applied to the open end, when a certain amount of detail below may be seen. The inside paint, and the material of which the tube may be constructed, depend entirely on the taste of the maker, but the tube *must* be watertight.—E. A. F.

Decoration for Curtains.

R. P. (*Demerara*) writes:—"I am glad to be able to send you the following easy and effective method of decorating curtains: Dilute Judson's dyes to mix to get æsthetic tints, and go over the pattern of lace curtains with one or more colours, as required. Then stain in the ground with another tint, and the effect is exceedingly pretty, and takes off that 'bed-roomy' look which white lace curtains generally suggest."

Seats for Eastern Divan.

R. P. (*Demerara*).—The fittings of an Eastern divan are known to me, I regret to say, sans the few examples in South Kensington Museum, only from books, and although since the days when first lost in the glamour of the "Arabian Nights," I fitted up one for myself in my "Spanish Castle," it has never been my lot to do so in the reality. As far as I remember, the Eastern rooms, shown in England from time to time, have had a raised step running round the whole room, not over 8 inches high, made of solid wood, with ordinary cushions, not quite so luxurious in fact as in fancy; and as the Anglo-Saxon wishes sometimes to vary his attitude, I think that at least 12 inches may be taken as the height of the framework, of good solid stuff, with webbing like the old-fashioned bedsteads, with thick mattress-like cushions on it, and either loose, standing against the wall at back, or cushioned like a second class railway compartment, a valance of stuff might hang down and hide framework. There is a striped material made, I believe, of waste silk, selling about 1s. 9d. a yard, at Little's, *Regent Street*, and Hampton's, *Pall Mall*, that would look sufficiently "Eastern" to suit this class of room, while Liberty's lists show a wealth of higher price materials in embarrassing variety.—J. W. G. W.

Cement for Every Kind of Work.

G. J. M. (*Greenwich*) writes:—"'Syndetikon is a liquid fish glue, warranted to be made purely of fish bladders and bone; it has proved the best cement for general use in every household. It pastes, glues, and cements anything that can possibly get broken in the house, parts of furniture, paper and feather articles, glass, porcelain, marble, alabaster and plaster figures, ivory, tortoise-shell, etc. Syndetikon resists any change of temperature, keeps unalterable for years in all zones, and may be, if necessary, rarefied with water or spirits of wine.' The above is copied from the prospectus (round a bottle I procured) printed in Berlin, but I cannot say who is the preparer of it, nor is there any address on the bottle. My bottle was procured by a friend from Mr. Hart, *Kingston-on-Thames*. All that the prospectus states of its powers I have proved to be true; it is the strongest and best cement I have ever met with, and requires no heating or other process before use. I have used it for repairing a cheese dish, and found hot water in washing had no effect on it. The smaller the quantity used the better. Care is required in taking out of the bottle not to touch the neck, or your stopper becomes immovable. For ivory carved work, as much cement as a pin's point will carry is sufficient to repair it or other delicate work. The prospectus has the description printed in seven different languages, but yet I have been unable to get it in London." [Why not write to Mr. Hart? As he seems to keep "Syndetikon" in stock, he may be able to give you the name of the maker, or the maker's agent in this country.—Ed.]

Treadle Tool-Grinding Machine.

An Amateur.—A second-hand iron wheel suitable for the machine described in my papers is worth about 10s.; the rest of the ironwork will cost about 15s. Employ a good blacksmith—avoid shops.—A. T.

Motor for Lathe.

A. Y. S. (*Waterford*).—A very good Hydraulic Motor is described by Cato, in page 502, Vol. III. A Turbine Water Motor for Amateurs will be described and illustrated with full-sized Working Drawings, in Vol. V., and an Electric Motor will be dealt with as soon as opportunity offers.

Renovation of Leather.

E. S. R.—You have no alternative but to re-cover the chairs with new leather. There is nothing that will restore the surface to worn leather. You can get good material at a reasonable rate from Messrs. J. Hewit & Sons, *St. Bride's Lane, Fleet Street, E.C.*, if you wish to do the work yourself.

"My Furniture, and How I Made It."

A Subscriber. — Descriptions will be given of other pieces of furniture in the style of those already treated in the papers bearing the above title. It is their quaintness of appearance, the easy method of manufacture involved, and the striking contrast they present to furniture made in the ordinary way that renders Mr. Mark Mallett's furniture generally acceptable.

Books on Boat Building.

H. P. N. (*Belfast*).—Perhaps some of the following may suit you: Model Yachts: How to Build, Rig, and Sail (Griffith, Farran, and Co.), 2s. 6d.; Boat Building for Amateurs contains instructions for Building Punts, Skiffs, Canoes, Sailing Boats, etc. (L. Upcott Gill, 170, *Strand*), 2s. 6d.; Practical Boat Building and Sailing, with Designs and Working Diagrams (L. Upcott Gill), 7s.; Yacht Designing (Horace Cox, 346, *Strand*), £3 3s. Several articles appeared on Model Boat and Yacht Building in Vol. IV. of "The Boy's Own Paper."

Copyright Laws.

F. A. E. (*Bailieboro'*) asks:—What is the law concerning extracts from copyright books? Can you give quotations from such books in another book or magazine? If so, to what extent? [To this I may reply: You can give extracts or quotations from other books and magazine articles in books and magazine articles written by yourself, provided that they are *extracts* or *quotations*, and that you duly acknowledge the source from which they are derived. You cannot import whole chapters, or entire articles or poems bodily into any work of your own. If you desire to do this you must obtain permission from the publishers or owners of the copyright.—Ed.]

Holmes' Ozone Bleach.

W. W. (*Horley*).—Holmes' ozone bleach, to clean prints, etc., price 1s. 6d. per pint, may be obtained of Messrs. Spencer and Co., Chemists, 251, *Gray's Inn Road, London, W.C.*, who will forward by post or rail, on receiving a remittance, any chemicals named in my articles.—J. B.

Working Models.

Norwich Shopkeeper.—Kindly refer to reply given to W. W. H., in page 592, Vol. IV.

Waxing Meerschaum Pipes.

I. F. G. (*Limehouse*).—1. No reply has been given to this question. I do not smoke myself, and know nothing about the process employed. It is therefore left to those who *do* smoke—and there are plenty of them about everywhere—to give instructions on the point. 2. With regard to making perfumes, see Vol. III., pages 344, 494, 594, 595. In page 595 is a recipe for making lavender water.

A Wee Bit Wrinkle.

Roselea writes:—"Here's a wee bit wrinkle how I think many of your subscribers could spread the name, the fame, and the sale of Amateur Work. Lend their volumes freely. I have the whole three, bound in your own boards, and they are seldom at home, the result being that most of the borrowers become subscribers." [Thank you for your able *practical* advocacy of the interests of the Magazine.—Ed.]

Bi-Monthly Appearance of "Amateur Work."

Magnet.—I will give your letter, as you request, "my" *very serious* consideration, but at present I must confess I cannot see my way to the inauguration of the scheme that you propose therein, for many important reasons. This Magazine will remain a *monthly* publication; the *bi-monthly* form is the worst possible for any serial work. Kindly write again referring to your previous letter, and append your name as well as address.

Tempering Tools.

No. 149 writes:—"When tempering tools to keep them from twisting, rub them well over with chalk before putting them in the fire to bring them to the proper heat."

Wheat Mill.

No. 149.—Experiments are now in progress with regard to an entirely new form of wheat mill. If these are satisfactory, the article, with illustrations, will be produced with as little delay as possible.

Hydrochlorate of Cocaine.

Nepenthe writes:—"Since writing my paper on 'The Construction and Arrangement of a Medical Cabinet,' it has been discovered that the *Hydrochlorate of Cocaine*, in $\frac{1}{16}$ grain doses, is a remarkably efficient remedy for *sea sickness*. It is administered in solution once in two or three hours. See 'Lancet' of September 5th, 1885, page 451."

Hints on Wood Mosaic.

Twist Drill writes:—"With reference to M. Maresca Raphaele's address, I sent it as it was placed above his shop, but his Christain name is Raphaele, it being the custom among the Italians to place the surname first." [English readers generally, not being aware of this, would suppose that Raphaele was the surname, but I do not suppose any letter addressed to "M. Maresca Raphaele" would fail to reach its destination, as his name, according to Twist Drill, appears thus on the facia of his shop.—Ed.]

Upholstery, etc.

Cabinet-Maker.—I think you will find that the whole field of your letter, with reference to upholsterer's work to be done at home, screens, etc., will be covered by Articles that, I hope, will appear in Vol. V. With reference to Fender Stools and Foot Stools, I am of opinion, like yourself, that an interesting and useful paper or two might be written on stools generally, and I leave the subject open to any one who will take it in hand for the benefit and information of yourself and others.

"Lime Ash" or Concrete Floor.

Vicar.—You will find the information for which you ask in Vol. IV., pp. 445 and 446, in Mr. Edwinson's paper on "Handy Work in Farm and Garden." The methods employed in making "lime-ash" and concrete *paths* and *floors*, are identical, and are fully described in the paper to which reference is made.

Cleaning Oil Paintings.

F. P. L.—You will find instructions for cleaning oil paintings in Mr. Brion's paper on this subject in Vol. IV., page 36.

Feeding Young Dog.

F. P. L.—The animal is apparently over fed, and the food used is not suitable. Starve the dog a little to let the stomach recover its tone, and then let it have the bones and scraps of the house, with a little dog biscuit occasionally. You can get dog biscuits of any corn-chandler, and sometimes of grocers and oilmen.

Model Yacht Building.

Model Yacht.—Papers going fully into the subject of Model Yacht Building are appearing, as you may have seen, in Vol. V.

Repairing Broken Sash Lines.

F. P. L.—To repair the broken sash line in the top sash of a window you must first take out the bead on the inside that retains the bottom sash in its place; this must be done on the side on which the broken cord is. Draw the lower sash out, and get some one to hold it back out of your way as far as the cords will permit. You are mistaken in supposing that there are only *two* weights, one on each side, in a window that has two movable sashes; there are four weights, two to each sash, and two on each side of the window. Having removed the parting bead between the two sashes, you will see at the bottom of the outer groove in which the top sash works, the piece of wood which covers the opening or *pocket*, which contains the weight that was attached to the cord that is broken. Remove this pocket, take out the weight, pass the line over the pulley and down the interior of the frame—you had better use a mouse; secure it to the weight, replace the weight, and then finish by ascertaining the proper length for the cord, and nailing the free end to the sash. Your error has been in supposing that there are only two weights to the window. The parting bead and top sash have combined to hide the other pulley from your observation. You will see it if you pull down any top sash and look at the top of the groove in which it works.

Defective Coils.

A. F. (*Clapham*).—Having accepted the author of "How I Made My First Coil" as your teacher, you should implicitly follow his instructions. When he told you to use No. 24 for the primary, and No. 36 for the secondary, he meant you to do just as he advised if you wish to obtain results similar to those experienced by him. Your departure from his line of instructions, however small they may seem to you, have produced the results of which you complain. With a pint Daniell cell you would only experience a tingling "pins and needles" sensation in the fingers. Try three pint cells in series, and then note the result. Of course, make the handles, but these will not in themselves improve the coil. Irregular winding will always impair the usefulness of a coil. Before you make your next coil, study carefully the article on "Induction Coils: How to Make Them," in Part 43, pp. 363—368, Vol. IV.—G. E.

Galvanometer.

H. A. S. (*Tunbridge Wells*).—In Vol. II. of Amateur Work, pp. 76—78 you will find full illustrated instructions on how to make this instrument. Kindly procure the volume, or the part containing the instructions. I cannot repeat them.—G. E.

Compact Galvanic Battery.

H. A. S. (*Tunbridge Wells*).—I know of no other battery more compact convenient, and useful for small coils armature work, etc., than Applegarth's Patent Corrugated Carbon Cell Battery. If you will write me particulars of the purpose for which you require the battery, and enclose cost of postage, under cover to the Editor of Amateur Work, I will place you in communication with the patentee and maker of this battery. In any case, before I can instruct you on how to make a twenty cell compact battery, I must know what you wish to do with the battery, and the money you are prepared to spend in the materials for its construction. If cost is no object, you may have a twenty cell battery small enough to be carried in your coat pocket, fitted with all the conveniences desired by you.—G. E.

Clearing Varnish.

J. C. (*Dursley*).—You say you "have mixed the receipt for varnish in page 262, Vol. III.," but "can only get a part clear by letting it stand in bottles, and pouring off the clear part as it settles." Your difficulty therefore is how to render the whole of the mixture fit for use instead of a part. Varnish only needs straining through muslin to clear it.—A Professional French Polisher.

Britannia Company's Combined Lathe and Fret Saw.

Ursus writes:—"If F. R. (*Croydon*) applies to the Britannia Company, they will give him a sketch of their new spring, which fits under the table, or supply one for 2s. 6d."

Le Page's Carriage Glue.

B. H. F. (*St. Petersburgh*) writes:—"Having been down in the interior for the summer, I did not see Phonetist's questions (Vol. IV., page 452) till I came back the other day. I got a friend to bring me 'Le Page's Carriage Glue' from England. Amateur Work I get with other magazines through a bookseller in Glasgow. If Phonetist will call and ask for Bertie Davidovitch, at *Vassily Ostroff*, 12th *Line*, *House* 19, *Lodging* 12, I shall be happy to get him anything he wants in the parcel way, through captains of steamers, and any magazine through my bookseller. I get Amateur Work generally on the first of each month, new style."

INFORMATION SUPPLIED.

Trap for Sparrows.

O. B. (*Jersey*) writes in reply to K. A. T., page 311 :—" Not seeing any reply to your query, respecting a trap for sparrows, I send a drawing and description of one that I find very successful. You could make one yourself with brass wire, wood, and a piece of netting with small mesh. Bend wire to shape shown in Fig. 3, and fix to base 9 inches by 16 inches, by ¾ inch thick. Cut two pieces of ¼ inch wood, 9 inches long by 2 inches, fasten together with two hinges and nail to end of base, opposite the end with the wire. In the centre of edge of movable piece, drive a piece of iron wire so that it projects 1 inch. Cut five pieces of ¾ inch wood, one 1¼ inch by 4 inches, two pieces ½ inch by 4 inches, and two pieces ¾ inch by 4¼ inches. Make a framework of these pieces as in the centre of Fig. 1. Drive a piece of iron wire in each end, and bend one in the shape of a crank, thus, —┐___. Make two uprights of two pieces of ¾ inch wood, 3 inches by 1¼ inch, taper them down to a point, both ends and in the centre, 1 inch from the bottom, bore a hole right through, and balance the frame on them by the pieces of wire. Fix the whole to the base with screws, so that the crank piece may just overlap the piece of wire driven into the hinged piece of wood. Now fasten the netting to the brass wire, so that it spreads right over the base, and tack the other end to the board. On the centre piece of the wooden frame a few grains of barley, hemp, etc., may be fastened with some pitch. Glue will not do, as it would wash off in heavy rains. Fig. 1 shows the trap set, and Fig. 2 shows it sprung. To set it, take hold of the wire frame and turn it back, so that the hinged piece of wood covers the netting. Now shut down the hinged piece until the piece of iron wire in the centre of it will just catch under the piece of wire bent as a crank. The spring in the wire frame should be sufficient to hold the wires together, so that the cover will not fly open. When a bird alights on either side of the frame, Fig. 1, the weight tilts the frame and turns the crank piece, thus releasing the cover and allowing the wire to fly over to its original place, carrying with it the netting, Fig. 2.

Cement for Fixing Lamps.

CASENHEM writes in reply to J. B. C. (*Wotton-under-Edge*), Vol. IV., page 407 :—" Your query is rather vague—gas lamps, oil lamps, or petroleum lamps? If the latter, plaster of Paris should suffice. Cause of failure, possibly uncleanliness. Thoroughly wash the parts to be joined, in hot water and soda. Be careful not to wash any lacquered or varnished parts, as soda water (at least the watered soda, I should say the hot water and soda) dissolves the varnish. When dry, try the plaster. If that refuses to hold, the following is infallible. Melt resin, size of walnut, tallow size of marble, and add and stir well together, adding plaster of Paris to the consistency of good thick cream. Apply hot. Sets as hard as stone, and very quickly."

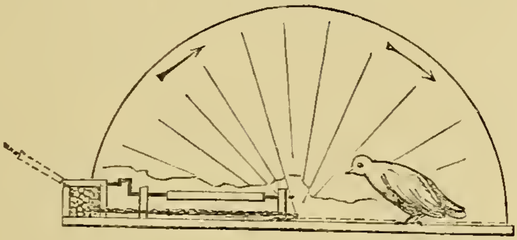


FIG. 2.

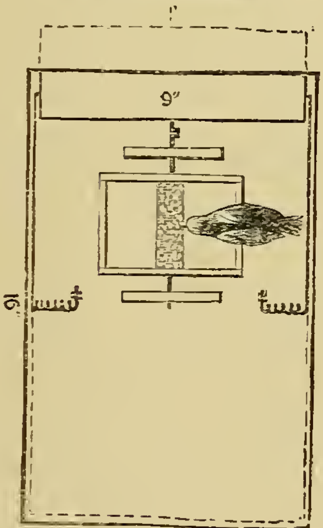


FIG. 1.

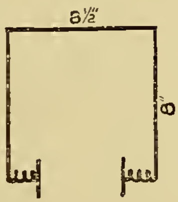


FIG. 3.

TRAP FOR SPARROWS.

Fig. 1.—Plan of Trap when Set. Fig. 2.—End View of Trap Sprung. Fig. 3.—Form of Wire Framing.

Planing Machine.

OLLA PODRIDA writes in reply to A. F. S. (*Dresden*) :—" Now I feel really sorry for our 'frequent' friend. He has at last laid himself so very bare; and it is the more lamentable that such should happen after the 'vapourings' he is wont to indulge in. Truly are the mighty fallen when they don't know how to keep things from slipping off a planer-table. And this is our whilom Mentor—self-ordained as such that things in the engineering world might generally be set to rights! It is all too evident that our poor friend has commenced at the wrong end of the ladder, and without seeing the danger has succumbed to the inevitable law of gravitation. Now that he has come down, let him start at the proper end, and learn how things may be kept from slipping off planer-tables. He has slipped *himself* off this time, a catastrophe which might have been avoided, or, rather delayed, had he provided himself with a good 'stop' in front of his organ of speech. Start at the foot, dear friend, not at the top. That is a very bad beginning as you are now aware. Start at the foot, I say, and work up very quietly, very quietly indeed, and never know more than your masters, or those that are your elders in experience. You have lots to learn, besides planing, and other technical things We have all got lots to learn—in fact, our education is never complete, live as long as we may, and your case, though very remarkable, is by no means exceptional. *That* may be of some comfort to you. Lastly, but not leastly, don't have anything to do with people who draw largely from imagination. Don't associate or hold converse with them. You know the proverb, and in these 'microbic' days it might lead to something very bad."

Foot Plates for Models.

OLLA PODRIDA writes in reply to A. F. S. (*Dresden*) :—" If the result on flat plates cut in a planer is 'not altogether as satisfactory as it might be,' then I am inclined to think it must be the fault of the tools, or the brass, or the weather—the latter most likely. Clearly there can be no other reason. I presume that you refer to locomotive models, but whence the convexity of foot plates? And supposing the foot plates are convex, isn't it just possible that they might be diamonded when flat and curved afterwards? "

Division Plate.

OLLA PODRIDA writes in reply to A. F. S. (*Dresden*) :—" As usual, you want a great deal for very little, or rather, nothing. You say that you have designed an 'improved' headstock for the purpose. Well, my advice to you is, that you adopt it at once, without beating around the bush with questions. It doesn't speak well for the 'improved.' If you have not time to make the concern it is your own fault. You should write a little less; by so doing you would evidently gain lots of time. If you want a division plate for nothing—the only way to avoid expense—try and get one honestly."

Addresses of English Gauge Makers.

OLLA PODRIDA writes in reply to A. F. S. (*Dresden*) :—" Joseph Whitworth and Co., *Manchester*. This firm makes gauges, and other things, in a general sort of way. They also make surface plates, but I am happy to say still employ *three* plates in the making of originals. They also make gauges in their old-fashioned way. But I have much pleasure in giving the name of the firm. It may lead to some improvements with resultant benefit to them."

Heliograph.

CASENHEM writes in reply to W. S. M. Vol. IV., page 407 :—" Do you require an explanation of Sir Henry Mance's system, as used in the Army—or an amateurish one. Shall be glad to help in either. The former I should think is hardly within the province of AMATEUR WORK."

INFORMATION SOUGHT.

Glass Eyes for Stuffed Animals.

PRESERVER asks:—Will any reader kindly tell me where eyes for stuffed birds and animals are made? I should be glad to have name and address of the cheapest manufacturer.

Ferns for Mounting Stuffed Animals.

PRESERVER asks:—Can any reader tell me the best way to prepare ferns to put in a case with animals?

Patent Laws.

F. A. E. (*Bailieboro'*) asks:—Can a person be prosecuted for making a patent article for his own use, or what is the law on the subject?

Quick Drying Black Varnish.

A. B. asks:—Will any reader inform me how to make a quick drying black varnish for cabinet work?

"Aurephone" and "Celestina."

R. A. R. B. asks:—Will any one tell me something about the automatic musical instruments known as the "Aurephone" and the "Celestina?" I want to know how many *reeds* there are in the "Celestina," and whether (the music being in long rolls) it is possible to play the same tune over again, as the separate verses of a hymn, etc.? Also, have the holes to be made shorter when cutting out the music than is necessary with an "American Orguinette?" as I believe the "Celestina" is constructed on the *lever* principle. If this is inserted in AMATEUR WORK, and meets the eye of Mr. G. Whight, perhaps he will kindly reply.

Vane with Working Figures.

TEMPUS wishes for a sketch of a vane with figures that work, either with a crank, or that swing their arms. [A short paper on this contrivance in various forms, would, without doubt, be welcome to many readers who would like to try their hand on simple mechanical objects of this nature.—ED.]

Punch and Riveter.

A. F. S. (*Dresden*) asks:—How can I make a punch to work by lever to punch holes $\frac{3}{16}$ inch diameter in $\frac{3}{8}$ inch brass and copper? And also, will close rivets on boilers up to 24 inches diameter? May work by screw, but lever preferred.

Catch 'em Alive.

A. F. S. (*Dresden*) writes to CHEMICUS:—"I have tried your receipt in p. 205, but find that not a fly will come within 10 inches of the paper, principally on account of the smell, I think. What is the object of soaking the paper in a solution of alum?"

Adherence of Filings to Drill.

NASMYTH writes:—"In boring through iron with an Archimedean drill, I notice that the filings it takes off, stick out from, and adhere to the drill, as if it was magnetized. What is the reason of this?"

New Money.

NORWICH SHOPKEEPER writes:—"In looking round at some of our shop windows I sometimes see a lot of new money exhibited. Can you or any of your readers tell me how and where to get some?" [I have sometimes seen bowls of new copper coinage exposed in windows of shops newly opened, as a "draw," a coin being given to every purchaser of articles up to, or above, a certain value. If I wanted anything of the kind myself, I should address a letter to, The Chief Clerk, *Royal Mint*, *Tower Hill*, *E.C.*, who could, and doubtless would, put any applicant in the right way to get some new coins of the realm. But some of our readers may be able to suggest an easier and shorter way of going to work.—ED.]

Astronomical Clocks, etc.

T. B. T. (*Carnew*) writes:—"A. H. has omitted to supply the name and address of the firm which supplies parts of astronomical clocks and regulators, finished and unfinished. Will he kindly oblige a subscriber by doing so?"

Corn Whisky.

Εκβολινος asks:—Will any American reader of AMATEUR WORK undertake to give directions for its manufacture, applicable at an isolated farm in Uruguay or Timbuctoo?

Home-Made Beer.

Εκβολινος asks, almost plaintively:—Will any one tell me how to make this? all about hops and their culture, and all about malt and malting and yeast? So far I have only the barley, such lots of it, and I'm so thirsty! [To answer every question conveyed in your appeal would cover a tolerably large area of paper. To begin at the end, I can easily believe you are tired of "square face," and long for a Dutchman's draught (I mean, as to quantity) of genuine home brewed. Yeast is the thick, white, almost spongy foam or froth that works up on the surface of beer, or liquor in fermentation. Malting is a long process, and is a trade in itself in this country. The grain is first steeped, and induced to sprout, then it is dried in a kiln. The sprouting deprives the grain of its mucilage and gluten, and by the process employed, the starch that it contains is converted, roughly speaking, into sugar, or into a sweet substance partaking of the nature of sugar. In brewing, the sugar is converted into alcohol. The process involves the several operations of grinding or crushing the dried malt into a coarse powder, mashing with hot water to make wort, and boiling the wort with hops. The liquor is then allowed to cool and ferment, after which it is stored for use. You would have no difficulty in brewing, but I do not think you could convert the barley into malt in a satisfactory manner. Still there may be means of doing this on a small scale, and I can only say that if any one is willing to give instructions on malting and brewing especially suited for colonists, I will produce them with much pleasure. You will find no difficulty in growing hops. The common hop (*Humulus lupulus*) a hardy perennial climber, requires a deep loamy soil, and can be propagated from seed, or divisions of the root in spring.—ED.]

Fret-cutting.

G. T. L. wishes me to state that he will execute designs for fretwork to order, at prices not exceeding those charged for ordinary ones. I will send his address to anyone who wishes for it, and who will send an envelope, duly stamped and addressed, for the information required.

Black Polish without Staining.

W. H. P. (*Devonport*) asks:—Can any reader inform me how to make a preparation by which to polish black without having to stain first and varnish after? [It seems to me that you want a combined stain and varnish. Stains of this kind for imitation of old polished oak and mahogany are made by the Torbay Paint Company, 26, 27, and 28, *Billiter Street*, *London*, *E.C.*, and a cheap and good brown stain for outdoor work is manufactured by Messrs. Friswell, Simpson, and Hollick, *Bushbury Works*, *Hackney Wick*, *London*, *E.* I am not aware that either firm supply a *black stain and varnish*, but this you can ascertain by writing direct to them.—ED.]

Carbon, Manifold or Transfer Papers.

CASENHEM writes:—"The receipt (Vol. IV., page 455) has been tried, but at its best is not either a rapid or clean one. Surely there must be a better way. I think a bibulous paper is used. Can any one assist me to *the right method* for making a quantity?"

Model Steam Hammer.

NASMYTH writes:—"I want to make a model steam hammer, as much like the one at Woolwich as possible. Will some amateur give me some ideas for it? I should like it about twelve inches high, with parts fairly proportionate to the original. What I most want to know is the way the steam is let in and out. I do not want it self-acting. I want it for a model workshop that I am making, with a stationary engine, forge, and hammer on base; lathe and machinery and blowing apparatus on floor above. Any hints on these subjects will be most acceptable. Has a model engine been described in AMATEUR WORK?" [Not yet, but Mr. Pocock has this matter in hand.—ED.]

SALE, PURCHASE, OR EXCHANGE.

*** This Department has been transferred to the Advertising Pages, in which it will appear for the future.

MISCARRIAGE OF QUERIES.

X. Y. Z. and LEX.—Will you kindly write again, and repeat your queries with reference to photographic matters. Your letters were sent to Mr. Pocock, X. Y. Z.'s on Aug. 19, and LEX's on Sept. 2. Non-receipt of replies caused me to inquire into the matter. Mr. Pocock writes:—"The queries you mention as being in my hands I have not received. Your messenger says he put them into the letter box in front door, *but there is no letter box*, so I suppose they were left at another house." Left elsewhere, or lost, no doubt! Nevertheless, as every query that is sent out is registered, there is always a possibility of picking up dropped threads and restoring missing links.

COMMUNICATIONS AWAITING REPLY

J. B.; W. G. B. (*Limerick*); MATTHEW STICKLEBACK; F. R. (*Croydon*); A. W. W. (*Gateshead-on-Tyne*); D B. A.; J. E. R.; J. B. S. (*Kennington*); W. E.; J. R. (*Barrow*); D. E.; THE BRITANNIA COMPANY; W. G. (*Taranaki, New Zealand*); L. S. D.; WAITO; A. H. A. (*Durham*); F. M. Y. (*Ryde*); PHILO-EDINENSIS; A. F. S. (*Dresden*); R. R. (*Belfast*); H. M. (*Honfleur*); HARGER BROTHERS (*Settle*); CASENHEM; W. J. A.; H. H. (*Canterbury*); A. J. S.; G. H. H. (*Canterbury*); ROUGH (*Scilly*); OLLA PODRIDA; W. W. (*Horley*); No. 149; C.H.S. (*Wandsworth*); H. G. D. (*Weymouth*); BATTERY; K. A. T.

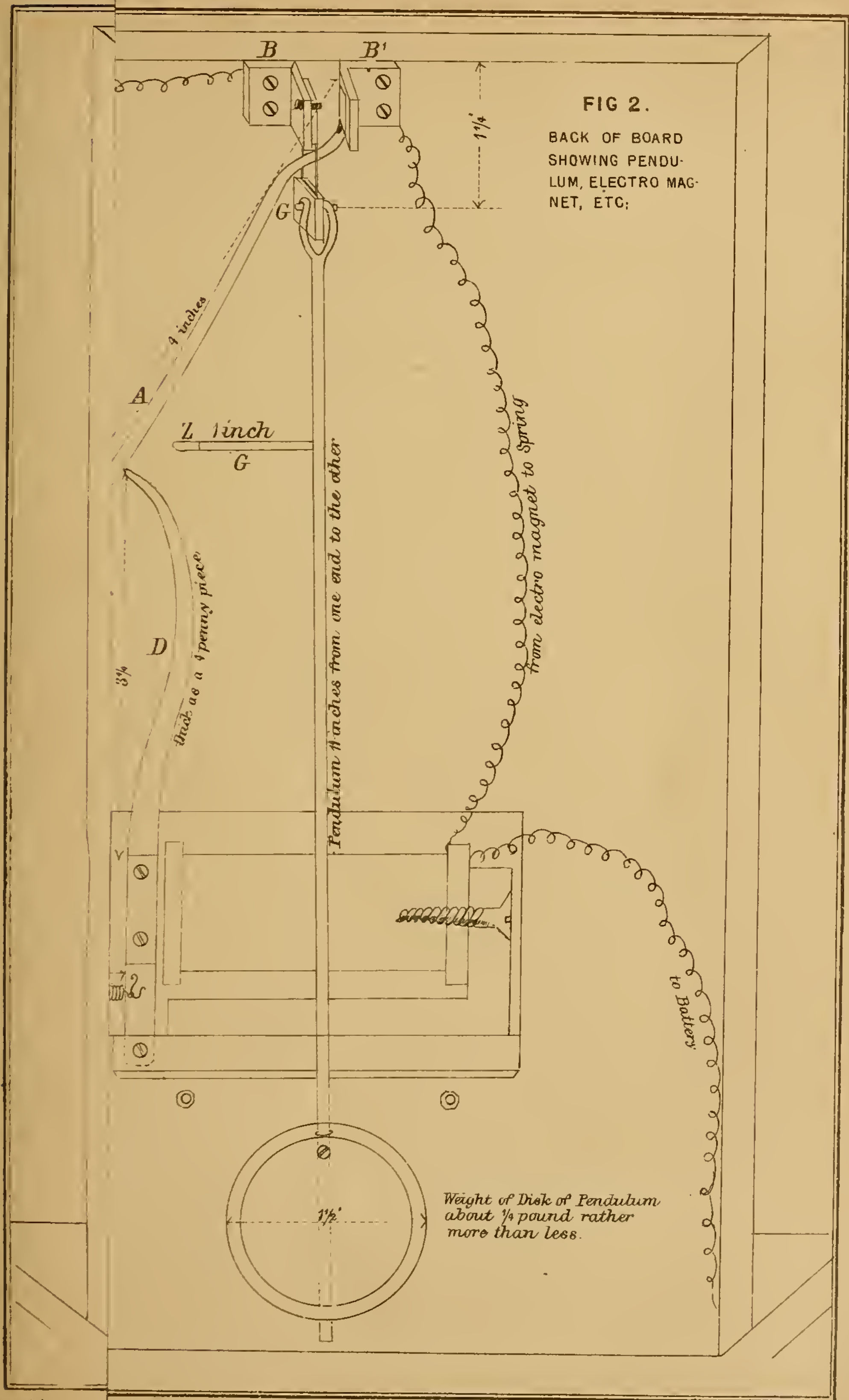


FIG 2.

BACK OF BOARD SHOWING PENDULUM, ELECTRO MAGNET, ETC;

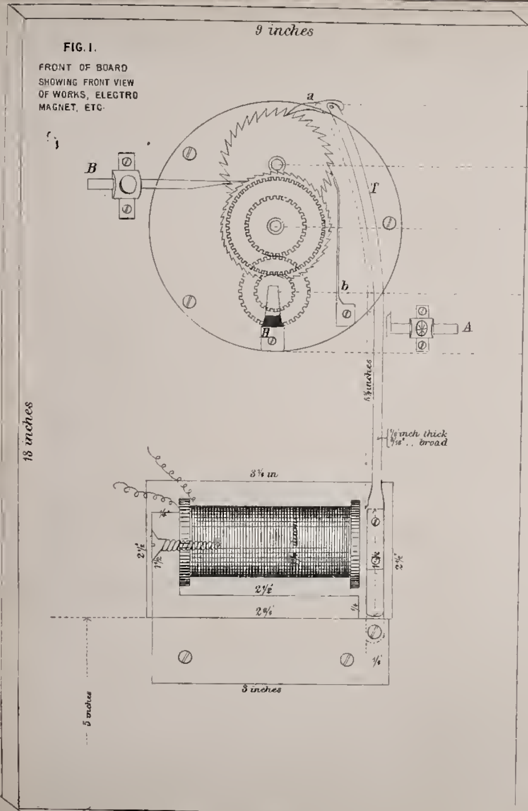


FIG. 1.
FRONT OF BOARD SHOWING FRONT VIEW OF WORKS, ELECTRO MAGNET, ETC.

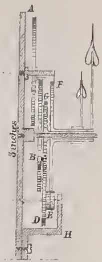


FIG 3.
SIDE VIEW OF WORKS.

AN ELECTRIC CLOCK

BY

L. MARISSIAUX

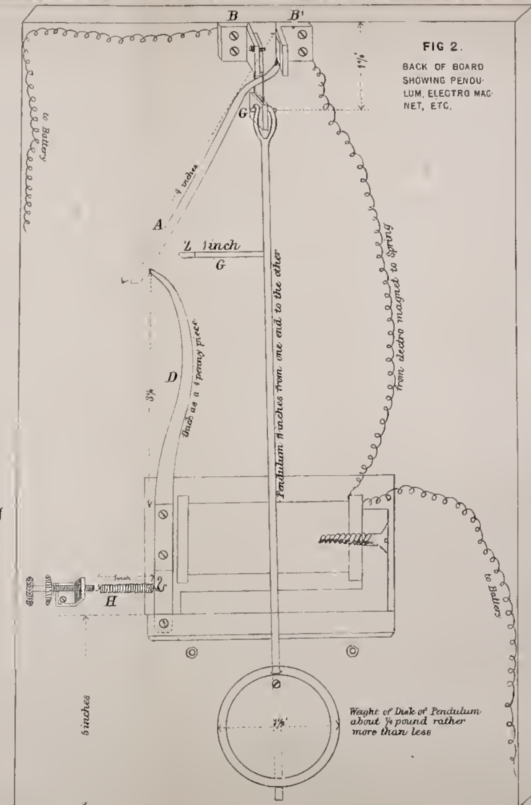


FIG 2.
BACK OF BOARD SHOWING PENDULUM, ELECTRO MAGNET, ETC.

A CHEAP AND EFFICIENT ELECTRIC MACHINE.

By O. BECKERLEGGE.

SOME years ago, when visiting in a family where there were several sharp boys, we were kept indoors for several days by a very heavy snowstorm. To interest the boys my ingenuity was drawn upon, but a pretty intimate acquaintance with electrical matters, they had to spend pounds on an instrument, would never obtain one, and others, if elaborate descriptions for complicated instruments were given, would hardly feel equal to commencing such an one. I, therefore, write for these, and if I can help the youth with shillings to find instruction and amusement in scientific pursuits, I will leave those who can command their pounds to other, and, it may be, more able hands. Just another word before we begin to work. Some few days ago I saw some disparaging remarks in reference to a cylinder machine, to the effect that

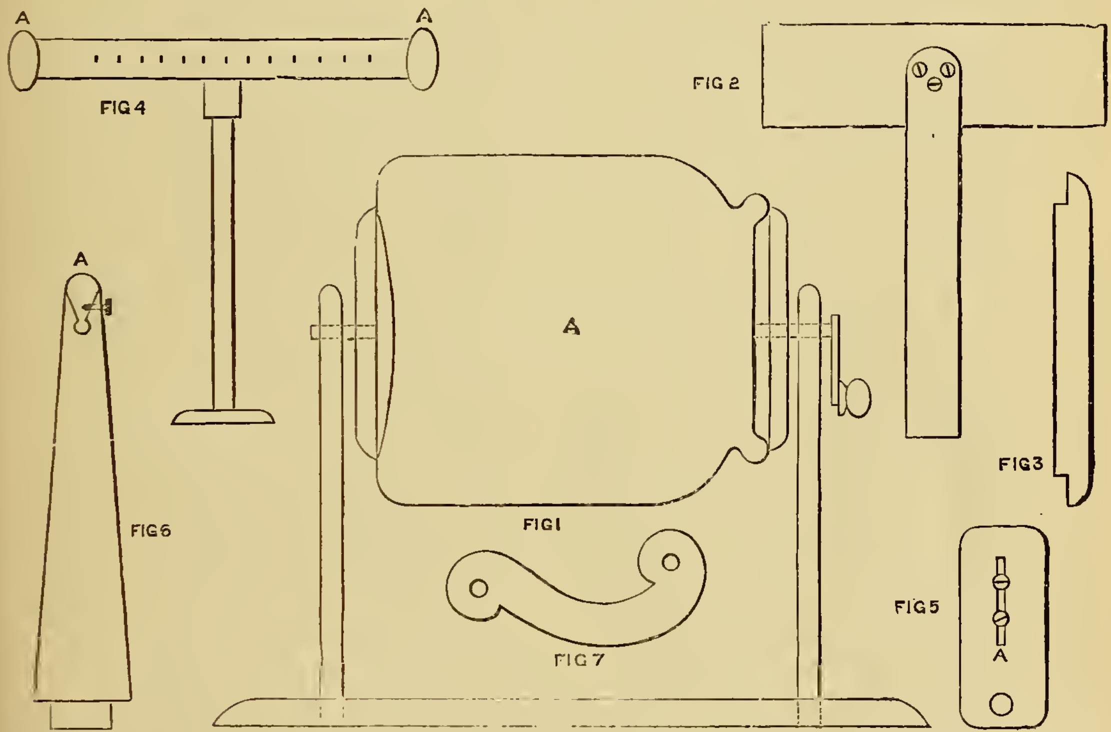


FIG. 1.—SECTION OF MACHINE—A, Sweet Jar for Cylinder. FIG. 2.—RUBBER. FIG. 3.—BUNG FOR OPEN END OF CYLINDER. FIG. 4.—PRIME CONDUCTOR—A, A, Brass Knobs. FIG. 5.—FOOT OF PRIME CONDUCTOR—A, Slot for Adjusting Conductor to Cylinder. FIG. 6.—STANDARD—Two required: A, Wedge fastened with small screw. FIG. 7.—CRANK HANDLE.

a sheet of brown paper, and a brush, kept them entertained for many an hour. The interest manifested led me to build up a machine for them with a twofold view—first, to give them information, and, secondly, to show them that the idea that expensive apparatus is always necessary is a mistake. Some of the best work ever done by scientific workers has been accomplished by instruments simple, and sometimes rude. In writing for the readers of AMATEUR WORK, and describing apparatus of a simple and inexpensive kind, it is not that I do not appreciate a good instrument, but because I know there must be thousands of intelligent readers who, if it is hardly worth while to make such an antiquated machine now that Wimshurst's Influence Machine is so much better. In reply to that I think it may be fairly said that although there is no comparison between the two for beauty and efficiency, so there is no comparison between the knowledge and skill required and the expense and trouble involved to construct them. The Wimshurst is a machine for one who has acquired electrical knowledge and skill, which, by the way, will come in time to the earnest student.

Now, then, to our work. I shall take for granted that my reader knows something of the history and manifestation of electricity; if not, then I must refer

him to some of the many handbooks or articles written on the subject.

In our instrument there are four essential parts—the cylinder, shown at A, Fig. 1; the rubber, Fig. 2; the prime conductor, Fig. 4; and the stand. We will begin with the latter. Procure a piece of wood, mahogany is best, though good pine will answer very well, 15 by 10, and 1 inch thick. Plane it very smooth, and round off edges and corners. It is a property of electricity to flow off a point more readily than from any portion of a sphere. We must therefore keep this in mind throughout our work—that there must be no sharp edges or points about it. Draw a central line through the length of the board, and mortise for two standards; the distance between must be determined by the length of cylinder. We will for the present suppose this, with its caps on the ends, to be 12 inches, therefore the mortise must be cut 12¼ inches apart. Cut two standards, tapering as Fig. 6, 3 inches at the base, and 2 inches at the top, and 9 inches high. Before the standards are tapered, square them up and draw a central line down their length; cut a tenon at one end to fit tightly the mortise in the base; from the shoulder of the tenon measure up 7 inches, and bore a hole in the central line. Do this to each standard, put them in their places, and see if you have made them to stand perfectly in line with each other. To make sure that the holes in the head of the standards are in line with each other, pass a wire through the holes, and see if it is in line with the longitudinal line on the base. Be careful that everything is square and true to the eye, for if our machine is to be cheap there is no reason why it shall be nasty, and nothing looks worse than the appearance of slovenliness in that which professes to be a work of love. When everything is as it should be, glue and wedge standards in place. We will now proceed to the cylinder. At any confectioner's you can get a green glass bottle, such as a manufacturer sends out sweets in; I have bought many for tenpence each; it stands perhaps about 9 inches high, and is, say, 7 inches in diameter, Fig. 1, A. You will want two wooden caps to fix to the top and bottom. I had them turned by a wood turner. The one for the top should be formed with a short bung to go into the jar, Fig. 3. In the centre of each drive a screw, a piece of strong wire, or small tubing, as centres for the cylinder to turn on. At one side the projecting bearing should be 1 inch long, the other should be 2 inches, and the outer end should be screwed or squared so as to adapt a handle to turn the cylinder. The caps must now be attached to the cylinder. To do this, place equal parts of pitch, gutta percha, and shellac in a jar; dissolve by heat in an oven, or by any other means which may suggest itself, only be careful that it does not get into the fire. I have found this cement equal to any requirement; it is most tenacious, and sets like a stone. Make the wood and glass hot, and before the cement has set, place the cylinder in its place, and by gently pulling and revolving it you will be able to centre it as accurately as is needed. It will have occurred to you that so far it is impossible to place the cylinder in its place, inasmuch as we have anticipated our arrangements. On the top of each standard a V-piece, A, Fig. 6, must be cut out, down to the hole for the bearings; the cylinder can thus be easily put in its place. A wedge of wood must then be made to fit the opening; a small screw will retain it in its place. We want now a crank handle to turn it. For this purpose, out of stout sheet brass cut a piece as Fig. 7. In one end bore a hole, and screw or square it to fit the spindle. It will be well to solder a piece to it, so as to make it thicker. If it is to be screwed, then a screwed washer should be put on the spindle first, then run the handle up to this; by this means some of the strain will be taken off the threads in the handle. In the opposite end of the crank another hole must be made. Now procure a large mahogany drawer knob, cut off the shank, and with a wood screw fasten it to the crank. We can now turn the cylinder easily.

The next thing that claims our attention is the prime conductor, Fig. 4. Procure a piece of brass tubing 9 inches by, say, 1½ inch diameter; or, if it is more convenient or cheaper, make or procure a tube of tin plate; pick up as cheaply as you can two brass door knobs somewhat larger than the tube, insert the shanks in the tube, Fig. 4, and solder as at A. You will thus have a prime conductor with hemispherical ends. See to it that there are no sharp points or edges left, everything must be perfectly smooth. Draw a longitudinal line on one side of the conductor, and in that line drill a number of small holes, say ½ inch apart, which shall extend from end to end as long as the cylinder. With brass wire make a number of sharp pins, say 1 inch long, solder the pins in the holes, the sharp points projecting. When this is done see that they are in line, of the same length, and quite sharp. At right angles to the comb we have now made, solder a tube in the centre of the conductor; this forms a socket for a glass pillar or leg. This can be made of a piece of glass tube, say 1 inch diameter, a straight lamp chimney, or even a large phial would answer the purpose. Take a piece of wood, Fig. 5, 6 inches long by 2 by 1; at one end bore a hole to receive the leg, at the other end make a slot 1 inch by ¼ inch. Cement the leg into the socket, and also into the foot. Having made the leg of such a length that the comb will come just to the centre of the cylinder, bring it so that the teeth shall just escape

the cylinder, as close as possible without touching. A couple of screws through the slot into the base board will keep it perfectly steady.

Our next work will be the rubber, Fig. 2. To make this we must take a piece of wood the length of the cylinder, 3 inches wide and ½ inch thick. On one edge of this nail a piece of basil leather, put a thick layer of hair or wool on the wood, and draw the leather over it and nail to the other edge. Now nail down the ends neatly, and we have a nice cushion. On the wooden back of the cushion nail a leg of wood, of a length that shall bring the centre of cushion to the centre of cylinder. I have found it a convenient plan to hinge this leg to the base. To the top edge of the cushion sew a piece of rough oiled silk, not such as you get at a chemist's, but a special kind to be procured of any instrument maker. This must be as long as the cylinder, and wide enough to reach over the cylinder and come within ½ inch of the comb. Procure, say, ½ oz. of amalgam at any dealer in philosophical instruments, mix a little with lard very fine and smooth, and lay a little on the cushion. Place the machine now made before a warm fire, with a silk handkerchief clean it from all dust, turn the cylinder, and with your hand gently press the cushion to the cylinder. One or two turns will be sufficient to excite it, which you will know by the drag of the silk flap on the cylinder. The drag will be strong enough to keep the cushion firmly to the cylinder. Let some one now apply their knuckle to the prime conductor, and they will succeed in drawing a spark. But we have again run a little too far ahead. I must lay special stress on the necessity of removing all sharp edges and points from the wood and metal; every edge or point will allow electricity to stream off. The next point is that all the wood work must be polished or varnished, else the wood would more readily absorb moisture, which would be fatal to our machine.

Take four dry tumblers, place them on the floor as four feet to hold a piece of dry wood, stand on this, with one hand resting on the prime conductor. If the machine is in good working order, which will be determined by the weather and condition of the room, the drier the better, your beard, supposing you have one, will appear luminous in the dark, and anyone touching you will receive a little shock. Now let someone turn on the gas, put your finger close to the burner, without touching it, the spark which will dart from you will ignite the gas, to the wonderment of the uninitiated. Whilst we are working we may as well make a Leyden jar: procure an open-mouthed glass, such as is used by confectioners as show-glasses, measure off a piece of tin foil as long as the diameter of the jar, and supposing the jar is, say, 8 inches high, the foil should be 6 inches deep. Lay a coat of good paste or strong gum on one side of the foil, and fix it smoothly to the inside of the glass close to the bottom, and leaving a clear space of 2 inches at the top. When this is fixed firmly, having no folds in the foil, cut a piece as large as the bottom, give this a coat of paste, and lay it on the bottom inside. Now cover the outside and bottom in the same way, seeing that the foil is on a level both outside and in, and not nearer the top than 2 inches; if much nearer than this it might, when highly charged, discharge itself over the edge. Now make a kind of cap or bung of mahogany to fit the top, take 4 inches of stout brass or copper wire, on one end solder a metal ball. Supposing you cannot easily get that, then take a small wood ball, say 1 inch in diameter, firmly drive the brass rod into it, and cover the ball with foil, seeing that the foil touches the rod. Now pass the rod through the cap of the jar, the ball being outside. Make a chain of copper wire long enough to reach from the end of the rod to the bottom of the jar.

Whilst you have been doing this we will suppose the paste on the jar is dry. Now place both the machine and the jar before a fire to warm them and make them perfectly dry. Bring the knob of the jar close to the knob of the prime conductor, and turn the machine. Sparks, with a crackling sound, will pass freely from the machine to the jar. When you have given, say, twenty or thirty turns of the handle, take hold of the jar with one hand touching the foil, and with the other hand touch the knob. I take for granted that you will say "Oh!" in a most emphatic manner, without the slightest premeditation or mental effort.

There is just a word or two more to be said before closing. Before the ends of the cylinder are cemented on, see that the inside of the jar is *perfectly dry* and free from dust. For some time before the end is fixed, place the jar in a warm oven, so that all moisture is absorbed. I would again insist on having all sharp edges and points removed from wood and metal parts. Let the wood be perfectly dry, made perfectly smooth, and well varnished or polished. By following these directions a good useful machine will be the result, the total cost of which will not be more than, say, three shillings.

It has been suggested, from time to time, that some of the papers which appear in this Magazine are beyond the capability of some of our younger readers. This must of necessity occur, as it is intended for skilled amateurs as well as for those unskilled. The result to be obtained, however, from the instructions given above may be achieved by any youth who has the will to attempt the making of the machine described.

MODEL YACHTS:
HOW TO DESIGN AND BUILD THEM.

By ARTHUR C. HIDE.

II.—The Hull—Materials—"Dug Out" Mode of Building—Block—Hollowing out Sections—Layer Method—Adjustment of Pieces—Marking off Water Lines — Roughing out — Gluing Layers—Deck—Keel.

I GAVE you in my last paper the way to put your model on paper. I will now endeavour to give you full instructions how to carry your design out in the wood.

The very first thing is to get wood that will not only stand damp well without shrinking, but will also be free from resinous matter and knots, and allow itself at the same time to be easily worked. My first model I made of white pine, and you can fancy it was more or less "riling" when one day she came to the shore, after I had been sailing her for some two or three hours, half full of water, the wood having shrunk, and the seams opened.

Perhaps had the seams been properly made, as I afterwards learnt to make them, the consequences would not have been so bad, but still I never used white pine again, and should advise my readers to avoid it. The best stuff you can get is Canadian yellow pine; and when you go to buy it try and get a friend in the wood trade to go with you, if you have one. I take it for granted you know enough about wood working to be aware that knots are things which can hardly be termed pleasant to work, so try and get your stuff with as few as possible, even if you have to pay a little more for picking and choosing.

Now there are two ways of building a model that I am going to explain. The first way is called "dug out," and is made from a solid block of wood.

The other way is the "layer" fashion, and consists in fixing a series of planks one on the other, and cutting the model out then. Of course, there *are* other ways of building, for instance, like a real vessel, and then making two halves, and joining them afterwards, and the diagonal method, but none touch the "layer" fashion.

Firstly, then, the block. Having procured a nice piece of wood *square* it up *exactly* to the outside dimensions of your drawing, which will be 30 inches by 7 inches by 7 inches, and mark off on each side the horizontal and vertical lines, and the slope of the counter and stern-post, and on each end put a centre line down. Then mark off the thickness of the keel, and the shape of your deck on the bottom and top respectively, and now you can begin to work with your tools. First, saw out pretty close to the line the part between the counter and stern-post, and then with a bradawl bore at each point where the vertical and horizontal sections cross, on the block, to a depth corresponding with the distance in the body plan, that the section on which you are boring is from the outside line, representing the square section of the block, or, in other words, measure off from the point of the bradawl, the distance the line V W is from section No. 1 on the respective lines C, E, G, K, M, P, and bore down to those various distances on the corresponding lines on the block. Treat the other sections in the same manner, boring down on each side of your piece of wood. You can either mark off the distance on the bradawl with chalk, or you can measure the distance, and put your nail there; the former is preferable though, I think. You can now set to with your gouges, of which you should have a fair assortment, both inside and outside ground, and pare off till you come to the bottom of the holes made with the bradawl. Rough it out firstly, and then smooth it up afterwards, carefully working across the curves, and not parallel to the water lines. The counter will have to be worked in gradually and carefully so as to run in nicely with the stern lines. Take care not to cut into the keel nor into the stem and stern-posts. When you have got her fairly into shape you can begin to hollow her out. Bore, with a centre bit, a couple of holes, one in the bow and the other in the stern, taking care not to go too deep, and having marked the thickness of your side all round the boat (about $\frac{3}{8}$ of an inch), begin with a pretty quick gouge to scoop out first from one end and then from the other, letting the pieces split off in the centre. Take care you don't go through the side, and keep on feeling, as you go down, how much wood you have to work on. Should you be unlucky enough to let your gouge slip through the side, patch it from the inside with a piece of wood, and the glue which I shall describe further on for the "layer" method. When you have hollowed her well out, finish up the outside with a rasp, and bits of broken glass, and, lastly, with sandpaper, beginning with coarse and ending with the finest, until there is not a lump or hollow or angle of any sort on her. Now mark off the sheer on each side, and run that off with a spokeshave; your model will then be finished, but I am afraid it will take you rather longer to do than to read how it is done. So much for the dug-out method, of which I am not an advocate, but which, like everything else, has its advantages and disadvantages.

For "layer" method you must use the same yellow pine, or rather not the same, as that would be rather impossible; but I should say the same sort of yellow pine, viz., Canadian. In this method you get a certain number of pieces, to correspond with the number

of spaces between your water lines, and each the thickness of those spaces; in this case it will be seven pieces, each an inch thick. You will therefore have to get your wood a little thicker than an inch, so that you can plane it up to an exact inch; and it will be a nice little job for you, if you can use your planes at all, to face these pieces up without the slightest winding on them, and to an even thickness throughout. If you cannot do this yourself, get a carpenter to do it for you, he will not charge much.

The widths of these pieces need not all be the same, as you will see by reference to Fig. 4; therefore, you must adjust your wood accordingly. Having got these several pieces in order, mark off on the top one the shape of the deck line. On the next piece mark off the shape of the first water line; on the third piece, the shape of the third water line, and so on, till the last piece, on the under side of which will have to be marked the thickness of the keel. The thickness of the stem and stern-posts must also be marked on the ends of each piece. I omitted to mention that a centre line should be drawn right round each piece of wood, and the midship section should also be marked right round.

FIG. 8.—DECK BEAMS FOR MODEL YACHT.

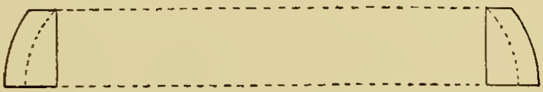


FIG. 7.—MODE OF PARING OFF LAYERS WITH GOUGE.

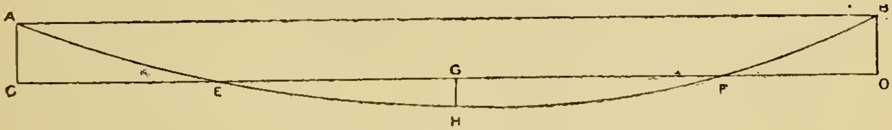


FIG. 9.—DIAGRAM FOR ROUNDING OFF "FORE FOOT."

To mark off the water lines from the drawing to the wood, you will have to mark off the different sections on the top side of each piece, and then measure from the centre lines the respective distances that the different water lines are on each section from X, Y, and then put in the curves with a spline. All this being done, take each layer and cut close to the line with a keyhole saw, cutting off all the four corners of the layer, and then with a spokeshave finish up carefully to the line. To test if you have marked off correctly the water lines, take each layer and place it on the half breadth plan, so that the centre line on that layer corresponds with the centre line on the drawing, and No. 1 layer should fall exactly along

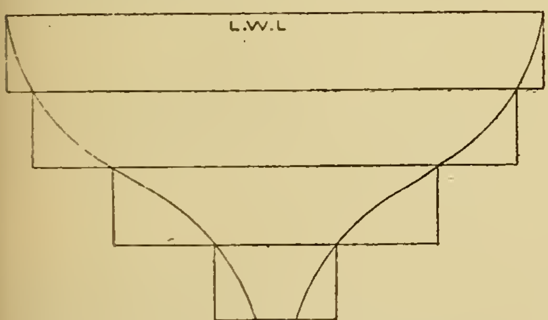


FIG. 4.—WOOD DISPOSED IN LAYERS FOR MODEL YACHT.

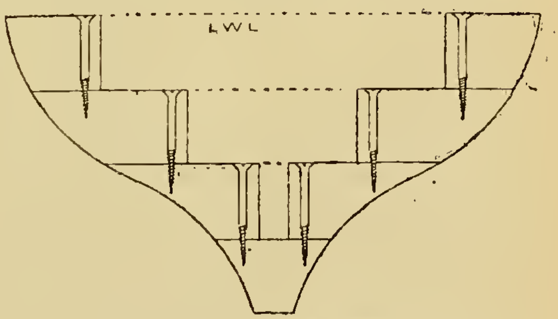


FIG. 5.—MODE OF FIXING LAYERS TOGETHER BY SCREWS.

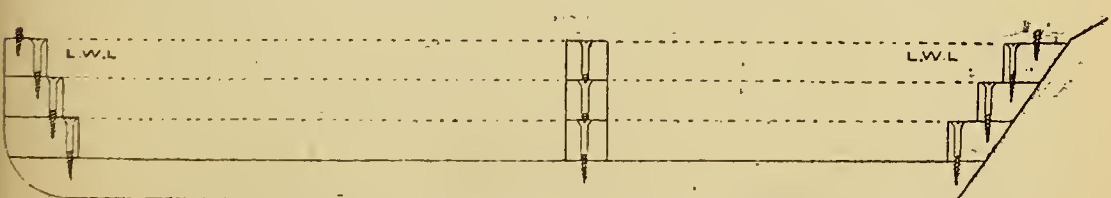


FIG. 6.—DIAGRAM SHOWING LONGITUDINAL VIEW OF LAYERS ATTACHED BY SCREWS.

the deck line; No. 2 along the first water line, and so on.

Now take the bottom layer and place the last but one on it, so that the centre lines and midship sections correspond exactly, and screw them together with a screw at each end, Fig. 6. (As the layers are 1 inch thick, a $1\frac{1}{2}$ inch No. 8 will be the best to use, and let them be of brass, not iron.) Then mark off on the midship section line a distance from each edge, where you can put a screw into the section underneath, without fear of its coming through the side, Fig. 5. Treat all the layers in the same fashion, and you will then have them all screwed together with four screws in each layer, two at the ends and two at the sides.

You can now begin paring off the corners and finishing up your model in the same manner as described for the "dug out," taking care not to go beyond the proper water lines on the top side of each layer. When the roughing out is completed, take her to pieces again, *e.g.*, unscrew the layers, and on each side of them mark all the way round the thickness your boat is to be—say $\frac{3}{8}$ inch, taking care to leave space round the holes where the screws have been, as these will have to be put in again. Now, with a key-hole saw, cut as near round the underside mark as advisable, so as to leave nothing but the outside shape of each layer, and then pare off the rest from the top side with a gouge afterwards (Fig. 7); but, once more, do not forget the screw holes. The bottom layer is, of course, left intact.

You will now have to turn your attention to the glue with which to join the layers permanently.

I came across some stuff quite accidentally, which answered the purpose "to a T." It was the composition they use for fixing down oil-cloths,* and can be bought in tins for 1s. each. This, diluted with a little spirits of wine, should be smeared on the bottom layer with a brush, and the next layer then screwed carefully into its former place. The others must be treated in the same manner, and when all are screwed together again, turn the boat upside down and place heavy weights on the keel. In this way it should be left to dry for about a couple of days, when you can begin to finish her up on the outside, and smooth her on the inside, just the same as for the "dug out." Cut the sheer also as described before, and then think about your deck. But, first of all, prepare two little beams, about $\frac{1}{2}$ inch deep and $\frac{1}{4}$ inch or $\frac{3}{8}$ inch wide, to go across the boat (Fig. 8), and let them into little niches made in the side. These tend to support the deck and, moreover, give it a curve, which not only looks prettier, but also allows the water to run off better.

* This composition is made, I think, by simply dissolving shellac in spirits of wine. At all events, the glue can be made so by those who cannot get the compo.

Now, for the deck, get either a thin piece of mahogany, if you like the look of it, or if you prefer a white deck (which, by the way, is apt to soon get knocked about and look dirty), select a fine piece of white pine not thicker than $\frac{1}{8}$ or $\frac{3}{16}$ inch, and having planed it nice and smooth on both sides, rule the top side to imitate planks, with a hard lead pencil. Then give a coat of good copal varnish all over, top and bottom, and let it dry, but do not put it in a dusty place, or the appearance of the deck will be marred to a certain extent.

While that is drying, you must excuse me if I ask you to set to work at your hull again. I omitted to say anything about the keel, which you will, no doubt, have noticed, looked frightfully clumsy, at $\frac{1}{2}$ inch thick. You should leave it the $\frac{1}{2}$ inch at the midship section, but from there taper it gradually both fore and aft, bringing the stem-post about $\frac{1}{4}$ inch thick and the stern-post about $\frac{3}{8}$ inch. The lines close up to the stem-post and keel will have to be fined away a little also. While we are about it, it may be as well to mention that a piece of hard wood, oak or teak, should be let into the front as a stem-post; the best way is to cut a piece of the present stem-post away, down to about the fifth water line, and screw the other in its place, putting a little cement in to make the joints, and trimming it into shape when in place.

By this time, I dare say your deck is dry; if so, screw it down with a small screw (brass $\frac{3}{8}$, "No. 3") at each end, and one or two in the sides, and then trim it off to the shape of your boat. It must not be fixed down permanently just yet, because you will have to get at the under side of it as you will presently see, but it should be taken off again when shaped down, as an undue strain is put upon the few screws that are at present holding it in place. Take care you don't loose your deck beams now, since they ought not to be fixed as it keeps the ship too rigid, there being always a certain amount of "working," in even a model when she is "under weigh," which it is as well not to prevent to too great an extent.

The keel will next require your attention, I think, but I shall only tell you in my next chapter how to find the weight that is really required to put her in proper trim, so I shall only suppose a certain amount now, and we shall see afterwards how far we are out. Suppose then you have found five pounds is required to bring her down to the water line, or rather say, suppose your keel is to weigh five pounds. Now a pound of lead contains 2·435 cubic inches; therefore, the cubic capacity of your keel would be 12·175 inches. Now the mean thickness is $\frac{5}{16}$ inch, the mean depth would have to be 1·8 inch, therefore, since the length is 21 inches (as the other 3 inches must be left for the rounding of the "fore foot"). Now make a

diagram like Fig. 9 (if there is room on your drawing do it on that) full size, by drawing a line 1·8 inch away from the keel line, and making a parallelogram through the extreme points of the keel by the lines A C, B D.

Now strike a curve with your spline and divide the lower part of it by the line G H. Then, if you think A, C, E is about equal in area to F, G, H, and B, F, D to G, H, F, your keel curve will be about right, but if not, you must alter it till you think these parts are equal, making the keel rather larger than smaller, since you can always trim a piece off but can hardly stick a piece on.

Now round your forefoot to fall easily into the curve of the lead keel, and then you can set about getting it cast.

Make a nice smooth pattern of it, and do not forget to make about four holes at different places right through, to admit of its being screwed on to the boat. If you go in for casting yourself, all the better, if not, get a founder to do it for you. When it is cast, weigh it, and I daresay it will not be very far out in its weight. Take off any superfluous weight with a spokeshave, and then trim it up nicely with a rasp, taking care to keep the surface which joins the boat flat and square with the centre line.

With a little putty underneath, screw the keel well home to the bottom of the boat with suitable screws, having first ascertained that it stands upright, or rather straight with the centre line of the boat, because a crooked keel is out of the question.

I shall give you in my next, how to find the real weight of the keel, as I think, for this month, you have quite enough to do.

(*To be continued.*)

THE REFLECTING TELESCOPE:
ITS CONSTRUCTION AND MANUFACTURE.

By EDWARD A. FRANCIS.

II.—METHODS OF WORKING—(A) BY HAND.

AS a rule in the mechanical arts, the march of time has been attended by radical improvements in the peculiar methods of working. Machinery has superseded hand labour, and the time required for accurate manufacture has consequently diminished.

The working of specula for the reflecting telescope, a fine rather than a mechanical art, presents a curious exception to this rule. This is in consequence, most probably, of the fact that the only method of producing a truly spherical concave or convex curve, is by grinding two flat or irregularly curved surfaces together, until the irregularities are removed, and that this method was adopted by the earliest opticians.

The material used in the construction of specula has varied, and the style of mounting has vastly improved; but the method of forming the curve has remained unaltered. Pitch, the medium adopted by Sir Isaac Newton, is still used in the polishing of glass specula; the isolated post or bench also remains in requisition by the practical optician, when specula of moderate size are to be worked by hand. Even the use of paper in the polishing process, which one would be inclined to consider a modern innovation, is taught in *La Dioptrique Oculaire*, published in Paris in 1671.

In one respect alone have we really advanced, and that is in the manner of testing, or the means of ascertaining at any moment during the process of polishing, the precise nature of the curve which we have communicated to the surface of the speculum. This advance has been necessarily attended by a more deliberate method of working, than that used by the old telescope makers, when, to quote a writer of their time, "perfection, to the most experienced and expert optician, was always accidental."

The application of machinery to this art might also be considered an advance, but that it simply imitates the movement of the hand on a larger scale, and appears to me an invention necessitated by the attempts to construct giant reflectors, and therefore one that would have followed in the natural course of events. In addition to this, we must remember that the finest specula are still figured by hand.

When a speculum is ground and polished without the use of a machine, it is almost invariably inverted on the tool: as illustrated in Fig. 9, of which Fig. 10 is a sectional view.

M. Leon Foucault, who introduced the modern silvered glass speculum, and who invented a method of testing—to be hereafter described—polished his specula face uppermost, using small polishers. The motion of the hand, when a large polisher is used, is not rigid enough to prevent the pressure falling heavily on the edge of the speculum, so destroying the accuracy of the curve. For this reason neither local polishing nor working with the speculum in an uninverted position can be recommended for small specula; though such, undoubtedly, must be and is the method adopted in figuring those of great size and weight, which are ground and polished *in situ*.

It may interest my readers to know that the largest perfect silver-on-glass speculum is that belonging to Mr. A. A. Common, of Ealing. It is 37 inches in diameter, 4½ inches in thickness, and weighs with its cell 11 cwt. It was with this instrument, which is of about 18 feet focal length, that the celestial photo-

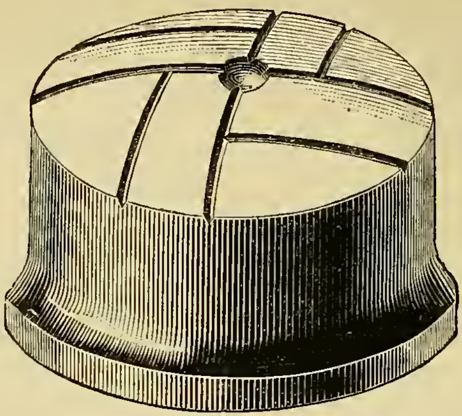


FIG. 11.—FIRST TOOL USED IN GRINDING SPECULUM.

graphs exhibited at the Inventions Exhibition at South Kensington were obtained.

A private manuscript, the authorship of which is attributed to Mr. Nasmyth, of selenographical fame, teaches a method (presumably that followed by its writer), in which the intended mirror, after being ground and fined in the inverted position, is polished face uppermost with a light full-sized polisher of wood coated with pitch. Evidently, this method of polishing would slightly flatten the spherical curve, which the speculum is supposed to possess when the last grinding with the finest emery is completed, and very goo l results might be obtained; especially since, if I remember rightly, the worker is instructed to avoid pressing upon the polisher, or carrying it at any time far over the edge of the speculum, lest the overhanging portion pressing downwards should turn back the edge of the curve too much.

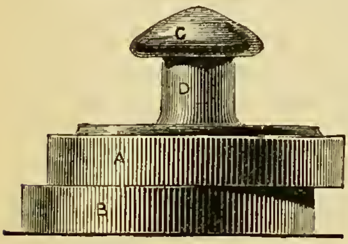


FIG. 9.—SPECULUM INVERTED ON TOOL.
A, Speculum; B, Tool; C, Wooden Handle turned to Screw into D; D, Metal Face-plate cemented to A.

With a machine circumstances are altered, for the polisher being almost uniformly controlled from beginning to end of the stroke, this turning back of the edge is avoided. The same end, a moment's reflection will show, can be obtained with less trouble and far greater certainty by working the speculum over the tool, when the tendency, unless the tool be greater in diameter than the speculum, is to deepen not flatten the curve.

The methods pursued by the old masters varied but slightly from each other, being generally different applications of the same principle by private individuals; indeed, it may be borne in mind that we are indebted almost entirely to amateurs (prominent among whom are, Newton, Mudge, Edwards, and W. Herschel), for the reflecting telescope. Had its improvement been left to the professional optician, there is little reason to think that it would have attained its present excellence; for while an amateur will ungrudgingly give his time, and often at considerable expense subject his plans to practical proof, the professional optician depending on the economy of his time for his income, cannot afford to enter upon a series of experiments which not unfrequently present no immediate promise of success.

The speculum metal (an alloy having a reflective power when polished only second to that of pure silver) having been cast into shape, was first smoothed at a grindstone, the edge of which was suitably curved, or ground on a convex leaden or pewter tool, grooved so as to allow the abrading material to circulate. Such a tool is shown in Fig. 11. The roughly ground concave was then worked upon a second tool similar in shape to the first, but formed of brass backed with lead, and having an unbroken surface, on which finer grades of emery were used. A third tool (Fig. 12), formed of hones cemented in small squares on a convex marble or metal base, was then brought into action. This removed all traces of the marks left on the brittle metal by even the finest emeries, and the speculum was subsequently polished with Tripoli or rouge on the brass tool, covered with a thin layer of pitch.

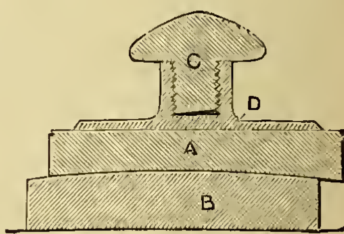


FIG. 10.—SECTIONAL DIAGRAM OF SPECULUM INVERTED ON TOOL.
References to Letters as per Inscription to Fig. 9.

Great virtue was commonly attached to the quality of the hones, special parts of the country being celebrated for their production; and it

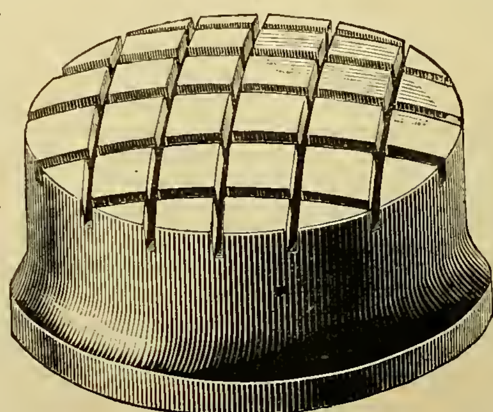


FIG. 12.—THIRD TOOL USED IN GRINDING SPECULUM.

required considerable skill to use them satisfactorily. The tools were in each case larger than the speculum. The first or grooved tool was one-third greater; the second (or brass) tool one-eighth greater; the third (or hone) tool one-fourth greater in diameter, and the polisher necessarily of the same size as the second tool. In addition to these a concave metal tool, similar in shape to the intended speculum, was used to true the other tools to the proper curve.

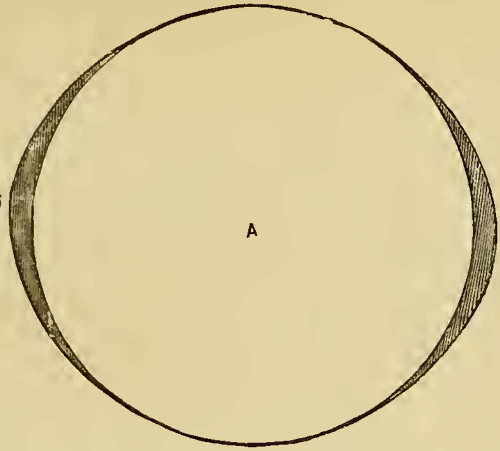


FIG. 13.—ELLIPTICAL TOOL OR POLISHER.
A, Speculum and Face-plate; B, B, Portions of Elliptic Tool, showing how it exceeds the Speculum in area.

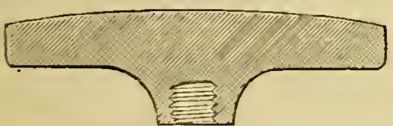


FIG. 14.—CONVEX METAL TOOL.

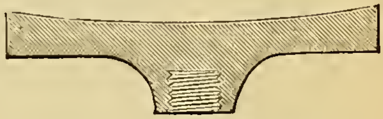


FIG. 15.—CONCAVE METAL TOOL.

The necessity for the second tool was afterwards disputed, and the grinders and polisher were shaped not circular but elliptical, the minor axis being the same as the diameter of the speculum, and the major axis to the minor as 10 is to 9. Such an elliptical tool or polisher, with a speculum of proportionate size, is shown in plan in Fig. 13, and was asserted to cause the completed speculum to assume the parabolic curve, the assertion being supported by no less an authority than Sir John Herschel: "In our own personal experience," he writes, "an oval polisher fixed in position and guttered at 45° to the axis has given results so satisfactory, at least for specula of $18\frac{3}{4}$ inches, as to lead us to rest in that construction." A precise inquiry into the action of the elliptical *polisher* will be made in subsequent papers on figuring; suffice to say here that a *tool* so shaped would cause the speculum at the end of the grinding to approximate to the parabola, for if the speculum and tool were equal in size, the curve obtained would, with care in the working, be spherical, tending only to shorten in focus. If the tool were larger than the speculum, the curve would be flattened, which would in some degree lessen the spherical aberration. This fact was of the first importance, at a time when the modern direct testing of specula was unknown. It is manifest that an elliptical tool would have precisely the same effect as the larger circular ones previously mentioned, with the advantage that a better command could be obtained over the curve by confining the stroke for any given time to one direction, that is, along the major axis of the tool to get greater wear on the edge of the speculum, and along the minor axis to retard that effect. Any design, however, to obtain the parabolic curve during the process of grinding must fail, the concave surface changing many times in the early stages of the polishing.

Attempts have been made to obtain, without the labour of grinding and figuring, a parabolic reflecting surface. In one case the fact that a wetted cloth stretched over a ring assumes a parabolic curve, was made the basis for experiments. In another it was sought to communicate the required curve to the surface of mercury by rapid revolution. In each case only a failure was recorded. The experimenters neglected to take into consideration, the infinite delicacy of the curve which they sought to obtain.

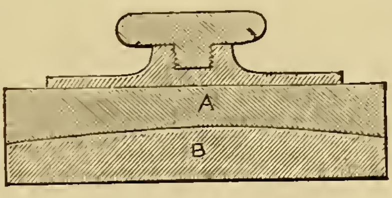


FIG. 18.—SPHERICAL FORMS OF DISCS OF GLASS A AND B OBTAINED BY GRINDING.

Secrecy was often maintained

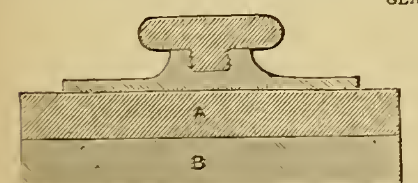


FIG. 16.—GRINDING WITH DISCS OF GLASS—DISC A EXACTLY ABOVE DISC B.

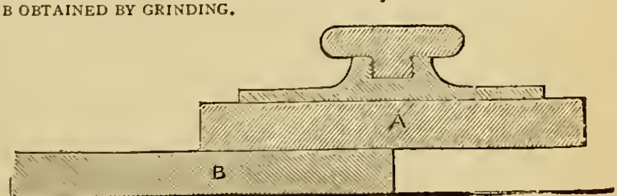


FIG. 17.—THE SAME, DISC A OVERHANGING DISC B.

as to the methods adopted, and this was rendered easy by the fact that while an ordinary machine or implement may be dissected, and its plan and parts imitated, no examination of a speculum will discover the means by which it was formed. It can be proved by observation that the curve is exquisitely perfect, but how perfection was attained must remain a secret, except the artist divulge his method of figuring.

So far from doing this, it is reported of "that truly excellent artist," Mr. J. Short, of Edinburgh, one of the old successful makers of Gregorian telescopes, that before his death, he directed his founder, Mr. Blackburg, to melt all his metal tools into one mass, lest the secret of his success should pass into other hands. Notwithstanding this, he forwarded a letter under seal to the Royal Society, in which he explained his method of giving the spherical curve to the surfaces of his lenses, which letter was to be opened posthumously. It contained a method perfect for its purpose, and exactly similar to the modern method of grinding specula. This modern method I will now proceed to describe.

The glass disc is roughed out to shape, on a leaden or zinc convex tool beaten or cut to a curve slightly deeper than that required in the finished speculum, the wear in the process of grinding reducing the tool and, consequently, the concave glass to the proper curvature. A pair of brass or soft iron tools is then made, about one inch larger in diameter than the intended mirror, the one convex (Fig. 14) and the other concave (Fig. 15). The convex tool, if above 8 or 10 inches in diameter, is divided into a number of small squares by a series of channels filed or cut by a machine, to a depth of $\frac{1}{16}$ or $\frac{1}{8}$ of an inch, and intersecting each other at right angles, so that the finished tool presents a chequered surface like a circular chess-board, only the squares are all one colour and separated by the small grooves. These grooves are cut to facilitate the equal distribution of the grinding material over the surface of the tool, but can be dispensed with as stated, if a small speculum only is being worked. Each tool is accurately cut in the lathe to a gauge, having the same radius of curvature (double the focal length) as the desired speculum. The convex tool is then fastened securely to a stout post or bench, and the concave worked over it in all directions, first with coarse, and after with fine emery, until complete contact of the two surfaces has been established. If necessary during this process, the position of the tools may be reversed, to prevent the curve deepening by the edge of the convex and the centre of the concave wearing away more quickly than other parts of the tools. This irregular action is reversed, when the convex metal is uppermost. The tools being ground to a true curve, the roughed out speculum, having a handle cemented to its back with pitch, is worked on the convex tool in precisely the same manner as the concave tool was worked, but with greater care. The curve of the convex tool is meanwhile preserved, not by reversing the positions of the tool and speculum, but by occasionally grinding the concave metal on the convex in place of the speculum, so that irregularities in the latter tool caused by the unequal wear of glass and metal may be removed. The more often the convex tool is applied, the more accurate will be the spherical curve communicated to the glass concave ; but if the worker fails to use the correcting tool at all or applies it insufficiently, the result will be unsatisfactory. Emeries of increasing fineness are used until the glass assumes a splendid fine ground appearance ; presenting, if viewed at a very oblique angle against the light, a polished surface.

If without scratches, the speculum is then fit for polishing. The polisher, a thin layer of pitch, is formed upon the convex tool if the speculum is polished face downwards ; if the reverse method is adopted, a light polisher of wood covered with pitch must be constructed. The metal tools should be of sufficient thickness to withstand without flexure the pressure of the speculum during the grinding and polishing ; one inch at least, in thickness if small, and if above 8 inches in diameter, strengthened by projecting ribs at the back radiating from the boss shown in the engraving. Indeed, this method of construction may be with advantage adopted for smaller tools, diminishing the thickness and the weight. The boss should be drilled and tapped with a coarse screw thread, conveniently of the same gauge as the mandrel screw of the lathe. A lathe, however, is not absolutely essential in the speculum grinder's workshop, but the tool should be capable of being securely fastened to a stout bench screw.

The foregoing method is an excellent one, and if the reader has the inclination and skill to construct the necessary tools, nothing better can be desired ; but it necessitates special tools for specula of different sizes—tools which would probably lie and rust on the shelves after one speculum had been worked with them.

A process which proved successful in the hands of a friend, who has since equalled the best productions of professional opticians, may be here mentioned. A disc of lead cast roughly to a convex shape in sand, was used to grind a concavity in a glass disc. A piece of thick slate was then cut and filed convex to the gauge, and when well dried, coated with French polish with a brush. A number of small thin plate glass squares were cemented with pitch on to the convex slate, which had been previously well heated ;

making a tool, in many respects similar to the hone tool of the old workers. On this tool the speculum was ground and fined. For a general idea of the appearance of it, the reader is referred to Fig. 12.

We now approach a method which the reader, having learned by the preceding part of this paper exactly what is required to produce a concave spherical surface, will most probably adopt. While the metal tools are necessary and economical when a number of specula of a given size and focal length are to be made, for the manufacture of a single speculum, the method about to be described is the simplest, and in the hands of the beginner the most effectual.

If two discs of any material are taken, and one constantly rubbed over the other in every direction, with an abrading substance between the surfaces, all irregularities will be removed; on the same principle that applies, when the stones of the sea beach are rounded by mutual action with the beach sand as the abrading agent. Returning to our first statement. The lower disc under this treatment will finally assume a convex spherical curve, and the upper become concave. This fact long known to mechanicians is, as has been shown, the basis of all methods of specula working. It remained for Professor Thomson to apply it in its simplest form. Dispensing with all tools of metal, he simply requires to grind a perfect spherical concavity, two discs of glass of equal size. It will be seen by reference to Fig. 16 where the disc, *a*, rests exactly over *b*, that the pressure is equally distributed. Let the upper disc be moved forward as in Fig. 17. Part of *a* will then overhang the edge of *b*, and the pressure will vary, being greatest at the centre of the upper disc and the edge of the lower.

If now, sand or coarse emery be introduced between the surfaces, and an oscillatory motion communicated to *a*, they will be abraded with a varying degree of action, greatest at the edge of the lower disc and the centre of the upper, and least at the centre of lower disc and the edge of the upper. This to-and-fro movement being continued in an ever-varying direction, the discs will speedily assume a spherical section as shown in Fig. 18, and the desired end will be obtained—a truly spherical concave surface. The same reasoning applies during the use of the finer emeries, except that the stroke is shortened when the desired curve (as proved by the application of a gauge) is obtained. A wide swinging stroke facilitates the abrading action, and vice versa. It is convenient to begin with flat surfaces, since the correct centring of the curve—a matter of the greatest importance—is thereby ensured. The convex glass can be afterwards used to render a second or third flat disc concave, but experience has proved that such a course is scarcely advisable, the concave showing a tendency to depart from accurate centring, except special care be taken to secure the opposite effect during the first half hour's work.

For this method, the disc of glass for the intended speculum, and that for the tool, should be of equal diameter; the action being different from that created when metal tools are used. In the latter case, the glass speculum is forced to assume the curve of a convex tool larger in diameter, the curvature of that tool being controlled and maintained by frequent applications of a concave metal. With Professor Thomson's method we have no concave, only the speculum, and if that were less in diameter than the tool upon which it was worked, the focus would rapidly lengthen (the curve flattening) as soon as the long swinging strokes of the roughing out were superseded by the shorter strokes of the fining process.

During this paper, I have introduced the reader to the grand influencing agent in speculum working—*length of stroke.*

From the time when fine emery is applied to the roughed out concave, until the silvered speculum is finally fitted into its cell, the whole process is one study of the effect of length of stroke. By varying this length, the spherical mirror may be rendered elliptic, parabolic or hyperbolic at will; and the great secret of parabolising lies in a nice perception of the exact effect of lengthening or shortening the range of the speculum over the polisher. Simple as the true appreciation of the effect of any given stroke at first view appears, practically it is extremely difficult to decide. Often in the "small hours" has the writer paused in his work, knowing that fifteen or even five minutes' steady polishing would serve to perfect the speculum then being figured, if only the exact stroke necessary to produce the required effect were known. It may be safely prophesied that many another will be in the same plight until experience has given power of judgment.

It was originally intended to continue these papers in one successive course, but as a composer introduces into his song an interlude, that the listener and the singer may not become wearied, so I have determined to interlude those articles which are necessarily descriptive and theoretical, with those entirely technical and practical. It is probable, too, that the reader will better appreciate an explanation of the effects of variation of stroke if he has first handled the rough speculum and tools. Let him then select a method, and in the next paper we will enter the glass grinder's workshop, and examine the requirements that belong to it, and the various fittings and appliances that must needs be found in it.

(*To be continued.*)

AN ELECTRIC CLOCK.

By L. MARISSIAUX.

(*For Figs.* 1, 2, 3, *Illustrations, See Folding Sheet given with this Part.*)

[I have much pleasure in calling attention to the following article from the pen of a French reader of, and contributor to, this Magazine. It has been translated by Mr. J. Pocock. I should have preferred to have given it in the original, but had I done so, it might have been comparatively useless to many readers who are interested in the subject.—Ed.]

ELECTRIC CLOCKS can hardly be called a recent invention; various wonderful specimens having been already produced although most of these are as costly as they are ingenious. Many of our French electricians (among whom may be named M. R. Houdin, the famous Parisian conjuror) have invented electric clocks which go as well as can be desired, some of them actually striking the hours, but at the cost of intricacies of mechanism well-nigh beyond the comprehension of all but those who are deeply versed in the mysteries of electricity.

The electric clock which I am about to introduce to the readers of Amateur Work does not strike the hours, indeed, but it goes with the utmost regularity. I can speak with authority, having made one for myself, with which I am completely satisfied; but I must own that I had considerable difficulty in finding a battery that would keep it going long enough, so as to avoid the necessity of constantly charging and recharging, a tiresome task which would do away with the merit and originality of the whole thing. The battery finally selected is that known as the "Cabaret," which I will describe to any reader of Amateur Work who may desire to construct one for himself.

Now, however, to describe the clock itself. It is composed of a thin piece of hard wood, as shown in Figs. 1 and 2, such as oak, mahogany, etc., 9 inches wide by 13 inches long, fixed upright upon another board of any convenient dimensions, the latter serving as a stand for the whole. These boards may be either varnished, French-polished, or simply planed, according to the degree of elegance and finish which the completed clock is to possess; for my own purpose I considered varnish would do sufficiently well.

At a distance of 5 inches from the foot of the upright board, a rectangular hole 2½ inches high by 3¼ inches long must be sawn or otherwise cut out. Within this hole, and *saddled*, so to speak, upon the thickness of the wood is placed the bobbin, or electro-magnet, with its support. The bobbin when complete is 1¼ inches in diameter and 2½ inches long, and it is made of wire, No. 20. I am not certain that wire No. 20 in France corresponds exactly with wire of the same number in England, but this is not a matter of great importance, since it will only cause a slight difference in the resistance. This magnet, as will be seen in Fig. 1, must be provided with a screw in the centre, for the purpose of fixing it upon its metallic support. This latter, now to be described, is fully illustrated as to form and dimensions in Fig. 4, A. It must be fixed by soldering or otherwise upon another piece of metal B, either iron or brass, by means of which the whole may be fitted into the opening in the upright board with two screws and their nuts. It will be remarked that a hollow has been prepared towards the right of this second piece of metal B, for the insertion of one end of the armature C, which is to be held there by means of two small screws, leaving it free at the same time for a to-and-fro movement against the electro-magnet.

The distance between this armature and the magnet must be the same as that required for the passage of one tooth or cog under the point *a* (Fig. 1), or the spring *b*. The arm T, which communicates movement to the seconds wheel A (see side view of works, Fig. 3), is about 5½ inches long: it is furnished at the upper end with a break *a*, turning on a pivot; and a stop A, Fig. 1, provided with a thumbscrew by which it may be regulated to the required distance, prevents the arm T, from drawing back too far, and taking more than one tooth per second. This arm T, when the rest of the works are completed, must be bent so that its point rests upon the tooth which is highest but one on the seconds wheel. The contact taking place every second between the armature and the end of the magnet, together with the pressure of spring B, will prevent the pushing on of more than one tooth at a time; but the especial object of the spring B, is to keep in place the seconds wheel, which would otherwise recoil to the extent of one tooth or more during the backward movement of the point A.

The seconds wheel (Fig. 3, side view of works, and Fig. 6) is provided with a hollow tube ¼ of an inch long, which serves to hold it in the axis A, Fig. 5. And above this tube is fixed a small square bar of fine steel which at each rotation of this seconds wheel engages and draws with it one tooth of the minutes wheel B, Fig. 3. A spring B, Fig. 1, fixed by a thumbscrew rests against the minutes wheel in order to prevent the passing of more than one tooth per minute, in the same manner as spring *b* acts on the seconds wheel.

The minutes wheel B, as will thus be seen, moves only once a minute. The hands also, instead of being in continual progression as in ordinary clocks, move only once a minute; but one seldom requires to know

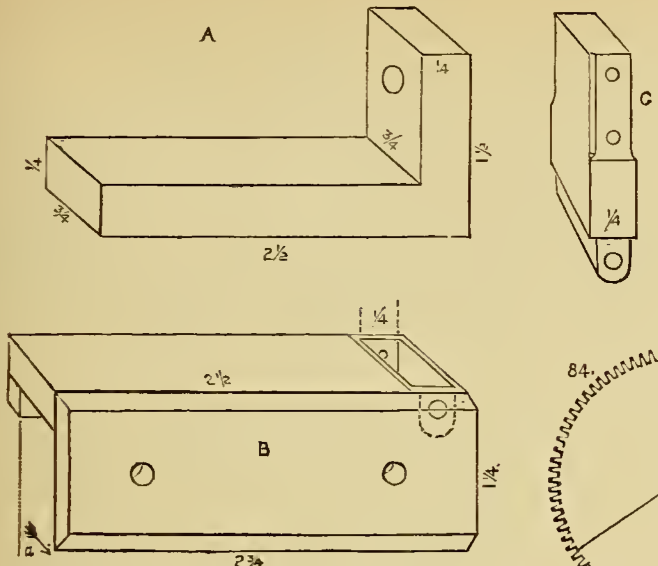


FIG. 4.—SUPPORT FOR ELECTRO-MAGNET AND ARMATURE.
A, Thickness of Wood of Board.

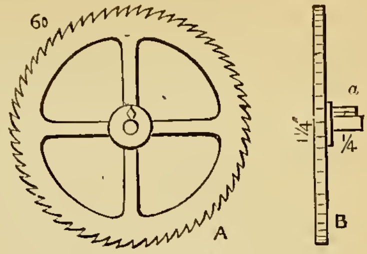


FIG. 6.—SECONDS WHEEL, SIXTY TEETH.
A, Plan; B, Side Elevation. *a* Catches into Minute Wheel.

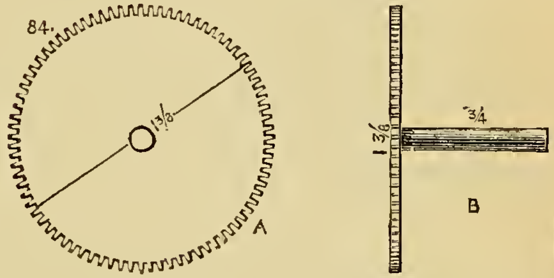


FIG. 9.—HOUR WHEEL, EIGHTY-FOUR TEETH. A, Plan B, Side Elevation.

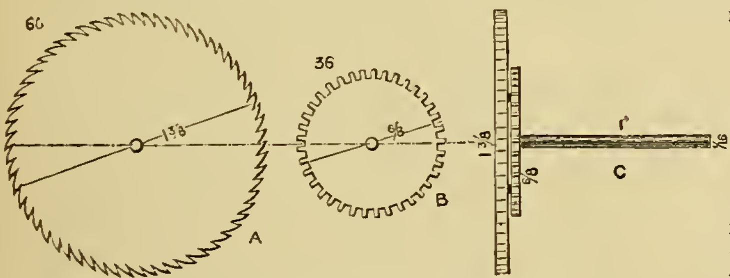


FIG. 7.—MINUTE WHEEL, SIXTY TEETH.
A, Plan of Large Wheel; B, Plan of Small Wheel, catching into Wheel in Fig. 8; C, Side Elevation.

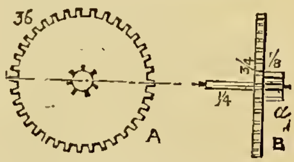


FIG. 8.—CONNECTION BETWEEN MINUTE AND HOUR WHEEL, THIRTY-SIX TEETH.
A, Plan; B, Side Elevation. *a* Catches into Hour Wheel.

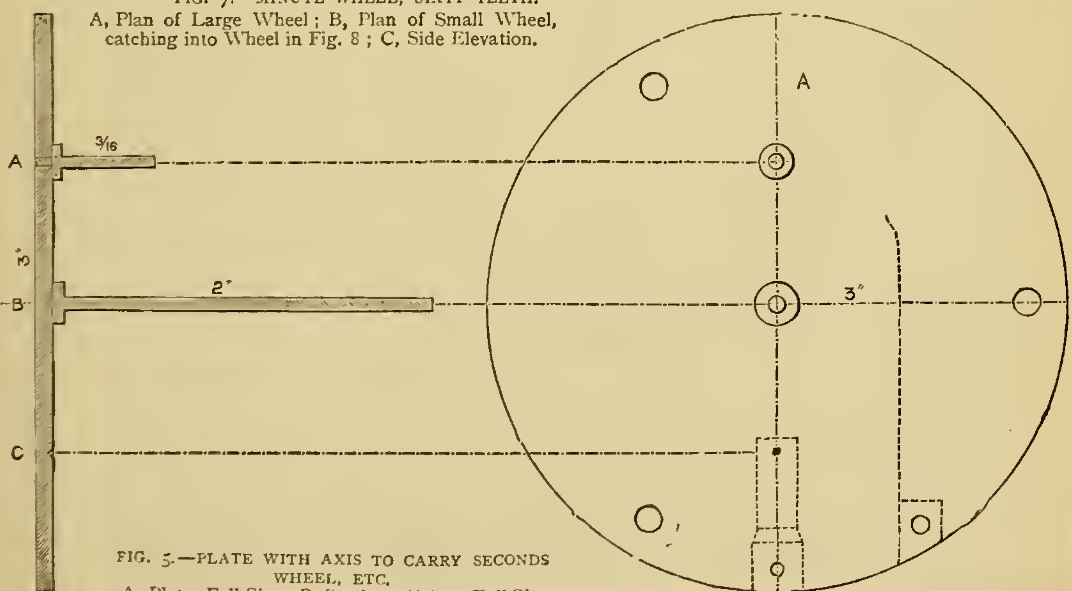


FIG. 5.—PLATE WITH AXIS TO CARRY SECONDS WHEEL, ETC.
A, Plate, Full Size; B, Section of Plate, Full Size.

what time it is to within less than a minute, and on the rare occasions when this is necessary, the beat of the pendulum will indicate the seconds with perfect precision.

The minutes wheel is now provided with motive power, and the wheel G (side view of works), which is attached to it, follows it naturally and communicates its movement to the wheel D, which again, by means of a pinion, transmits motion to the hours wheel F. For full details as to form, size, etc., of these three wheels, G, D, F, see Figs. 7, 8, and 9. I do not give the dimensions of the support H, Fig. 3, because these must depend on the amount of space taken up by the mechanism.

The mechanism belonging to the other side of the upright piece of wood is represented in Fig. 2, where we have, first, two small pieces of brass, B and B′. These are bent at right angles, and from the one B, depends the pendulum, while the other B′ supports a steel spring A, about four inches in length. This spring A, must be neither too strong nor too weak. It must be strong enough to oppose the pendulum, whenever its bar G, the end of, Z, which is platinised, comes into contact with spring A, and it must not be so strong as to resist the repulsion of the check D.

To the piece B is attached a small plate of brass, connected with a similar piece of brass hung below it by means of two ribbons of steel, which must be very fine and narrow, so as to be extremely flexible ; and between these latter passes the spring A. Through the lower plate is passed a small pin G, upon the two ends of which the pendulum is hooked. Upon the spring A, at the exact spot where it has contact with the tip Z of the bar G of the pendulum, a small plate of gold or platinum must be soldered. The pendulum must on no account be less than eleven inches long, and the disc at the lower end, which by means of a pressure screw, may be fixed lower or higher for the regulation of the clock, must weigh about a quarter of a pound (English), rather more than less.

From the electro-magnet one wire passes to one piece B′ (Fig. 2), and serves to establish the current between the spring A and the tip Z of the bar G of the pendulum ; the other wire passes from the magnet to the battery ; while the second wire from the battery itself is fixed to the piece B, and is thus in connection with the pendulum.

Let us now suppose that we wish to start the clock, which, in the accompanying figures is, of course, shown in a state of inaction, we have only to push the pendulum towards the left or right ; the point Z, will presently touch the spring A, thus completing the magnetic circuit, when the armature is attracted, and the arm T pushes one tooth forward (see Fig. 1), and the movements we have been describing take place.

When the pendulum has reached the limit of its swing towards the left, it returns, being pushed back both by its own weight and also by the spring A (Fig. 2). This spring is stopped and the current interrupted by the check D, and now a spiral spring H, fastened to the lower part of the armature, acts on the latter and draws it backward—that is to say, towards the left, causing the arm T, also to draw back, which enables it to engage another tooth of the seconds wheel in readiness to push it forward on the current being again established ; and this will take place as soon as the point Z of the bar G, the pendulum again comes in contact with the spring A, and so on, *da capo al finale*.

It will be seen that the movements of this clock are the result of two forces, that of the electro-magnet and that of the spiral spring H ; and the first impulse being once given, the clock will go as long as the battery power is strong enough to overcome the resistance of all the springs.

The degree of tension of the spiral spring H (Fig. 3) is very important ; it is regulated by a double screw to the left of the spring, to which the spring is attached at one end.

I must now warn those of my readers who may desire to construct an electric clock for themselves, that the dimensions of the accompanying illustrations are not drawn to scale, although the dimensions given in figures may be thoroughly relied upon, since they are all taken carefully from the different pieces of my own clock. I ought also to say that the wheel F (see side view of works, Fig. 3) is represented smaller than it should be, so as not to conceal the minutes wheel behind it ; and it follows, as a matter of course, that the wheel E is too large. Exact measurements for these wheels are, however, given in Figs. 6, 7, 8, and 9.

My clock is enclosed in a carved wooden case, with a face of darker wood, the figures being of gilded brass, which produces a very ornamental effect ; but I should recommend anyone who can obtain the glass to make a glass case for the clock, thus exhibiting the whole of the mechanism, which would be a very interesting sight, and prove well worth the extra trouble which might be involved in some cases by the adoption of this course, although I may say that the construction of the case in such a manner that the works within it are entirely exposed to view, is attended with no greater difficulty than that which must be encountered in making a case for a stuffed bird. The back and bottom of the case will, as a matter of course, be of wood, the top, the front, and the sides of glass. If any of my fellow-readers of Amateur Work should require further details or fuller information, I shall be happy to furnish them with the same in "Amateurs in Council."

PRACTICAL SCENE-PAINTING FOR AMATEURS.

By HENRY L. BENWELL.

IX. — METHODS OF DRAWING THE SUBJECT ON THE CANVAS FROM SMALL DESIGNS.

IT is absolutely necessary for the scene-painter—be he amateur or professional—to make a water-colour sketch of his scene from which to paint from. That is, if the work is to possess any merit as a piece of good painting, or other qualification. This design or sketch must be a scale drawing on paper, thus : Suppose the scene we wish to paint is to be 15½ feet wide by 12 feet high, we can make our sketch to a scale of either an inch or half an inch to the foot. To make the case as clear as possible, we will in this instance decide on an inch scale, therefore the design must measure 15½ inches by 12 inches. Each inch on the paper representing 1 foot on the canvas. The sketch may now be made.

I must now explain how to transfer the design from the paper to the canvas. There are two methods known to the writer for enlarging designs in scene-painting, both of which it will be necessary to explain, as the first, although well adapted for amateurs, sometimes hinders the movement of a good freehand artist, and so mars that bold effect so necessary in scene-painting. Before commencing to sketch in the design, however, it is of course necessary to prepare our canvas, and see that it is taut, and hanging square or perpendicular. The first thing to do, therefore, is to strike a base and a horizontal line. The base line should just clear the tacks at the bottom of the canvas (see Fig. 49).

I must here explain the method of "striking" a line. This is done with the chalk line and charcoal. Select a soft piece of wood charcoal, and fastening one end of the line to a nail, proceed in the same way as a line is chalked, viz., work the charcoal up and down the line until it is thoroughly black. Now, having measured the correct distances on each side of the canvas, hold one end of the line close up to the canvas, getting an assistant to hold the other end, both parties keeping the line perfectly tight. Now pull the line out from the canvas with the other hand, as near the centre as possible, and quickly release it, when a well-defined line should be imprinted on the canvas.

The next proceeding is to "strike" in this way the horizontal line on the canvas. The height of this line depends on the subject to be painted, and the artist himself. It should never be too high for stage scenery, but still, the subject has most to do with it. The centre of this line must next be found, and this is quickly done by running the chalk line over the canvas, and then doubling it and holding the doubled line along the horizontal line from either side of the canvas, the length of line thus giving the centre (see Fig. 49).

We now require a perpendicular line, and this may be obtained by means of the plumb-bob and line. Should the painting frame—as is sometimes the case—either not hang or stand exactly perpendicular, or, more commonly speaking, be "out of the square," the following is the way to find a perpendicular line in such cases.

Referring to Fig. 49 it will be seen that the diagram is somewhat exaggerated as regards the frame not being square, in order to make our meaning more clear. From the centre of the H L, at A, describe the circle B B. From C describe the arc D D. From E describe the arc F F. A line struck between the two

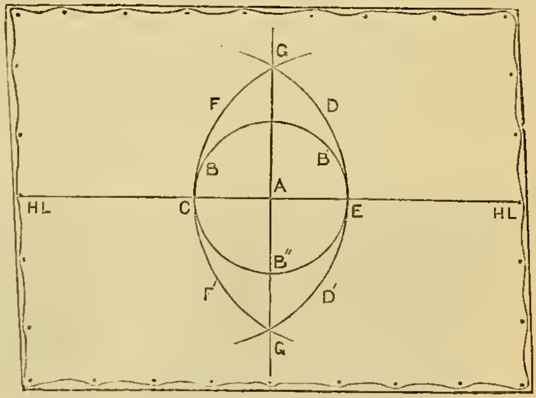


FIG. 49.—METHOD OF DRAWING HORIZONTAL AND PERPENDICULAR LINES ON THE CANVAS.

points G G, will be an exact perpendicular. A bent pin, a piece of string, and a pencil, is all you require to work out this little problem. I should say, however, that in describing the circle, the length of the string from the pin at centre to the loop for insertion of pencil, should be in length, one fourth the height of the scene.

There is now on the canvas a horizontal and a perpendicular line. These lines are of the greatest value and importance, and it is from these lines, that all other lines on the canvas have to be measured and drawn.

I think we may now safely proceed to transfer or enlarge our subject on to the canvas, and, in order to explain as fully as possible the *modus operandi* to my readers, I have prepared two small and simple drawings, Figs. 50 and 51, which we will take for the water colour scale drawings.

The first of these cuts, Fig. 50, is taken by permission from one of French's "Scenes for Amateurs,"

previously alluded to, and represents an attic. Supposing my sketch to be $15\frac{1}{2}$ in. by 12 in., we will take that measurement as our guide. It will be seen on reference to Fig. 50, that it is divided into inch squares — the numbers representing so many inches. These squares are ruled faintly with a pencil, in order that the design may not become too much confused. Having prepared our

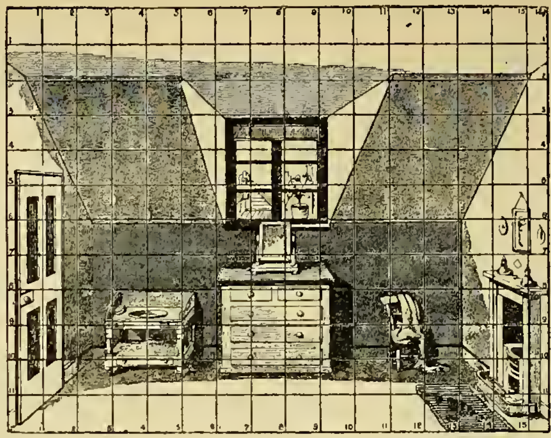


FIG. 50.—DESIGN FOR ATTIC SCENE IN SQUARES FOR ENLARGEMENT.

sketch in this way, we now proceed to draw the enlargement on the canvas with a piece of charcoal as follows: Taking the chalk line and charcoal the same number of lines are struck on the canvas, but in this case they are divided into feet, being previously measured off all round with the rule, so that, with the help of an attendant, the lines are struck quickly and true. The sketch and the canvas is now divided longitudinally into fifteen and a half equal portions, and into twelve vertical portions in the same manner, one being square inches and the other (the larger) square feet. It will now be a very easy matter for the artist to copy the contents of each small square in the sketch into the corresponding large squares on the canvas, and so correctly draw in his scene. Fig. 52 represents the canvas scene enlarged in this way, and the painter has here a good suggestion for an attic or garret

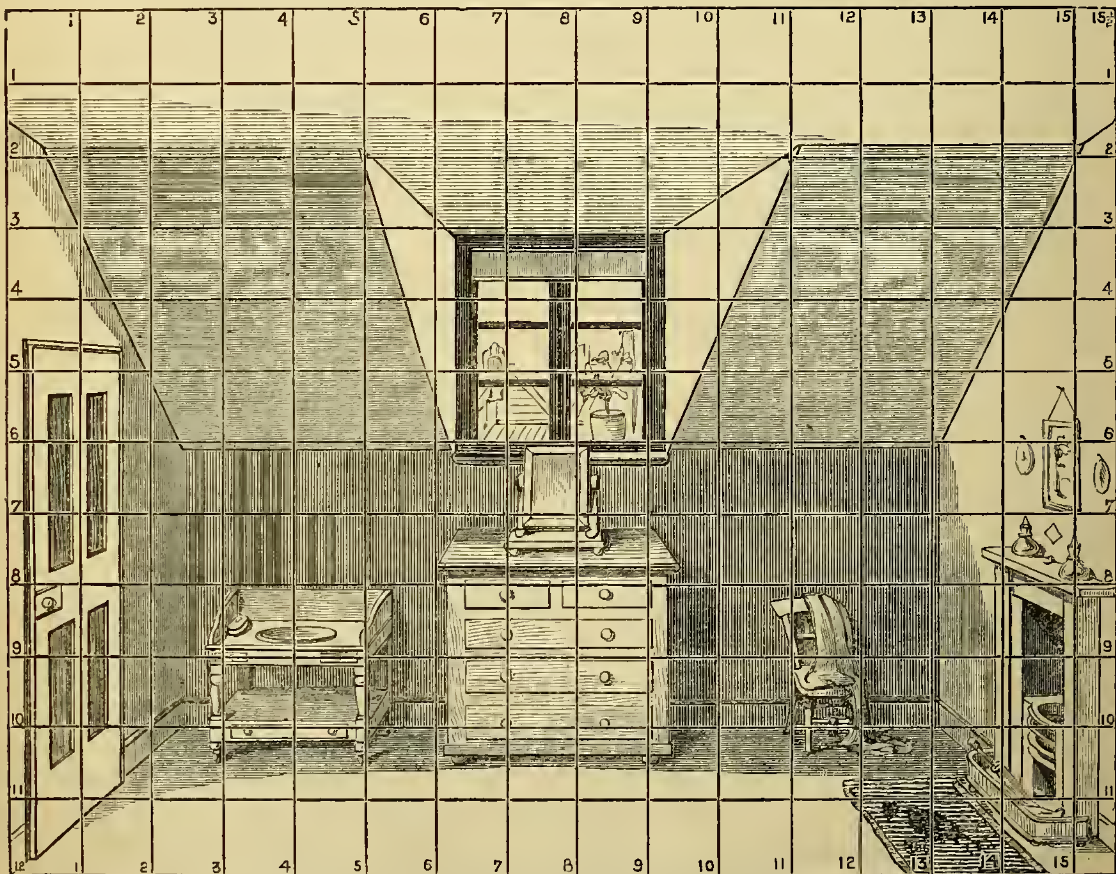


FIG. 52.—ATTIC SCENE ENLARGED ON CANVAS BY MEANS OF SQUARES.

scene. It would, however, be advisable for the novice to make a coloured sketch some four times larger than the illustration here given, or draw it to an inch scale, if only for the sake of practice in scale-drawing.

To an old hand the half-page cuts exhibited here would, as a rule, prove quite large enough to paint from, as he would probably have recourse to the other method I am now about to describe. I might mention that this method of drawing by scale, as well as the succeeding, can be employed on a scene of any size; but the painter must take care to mark off the divisions on the borders all exactly equal, so that the portions into which the sketch and canvas are divided are all perfect squares.

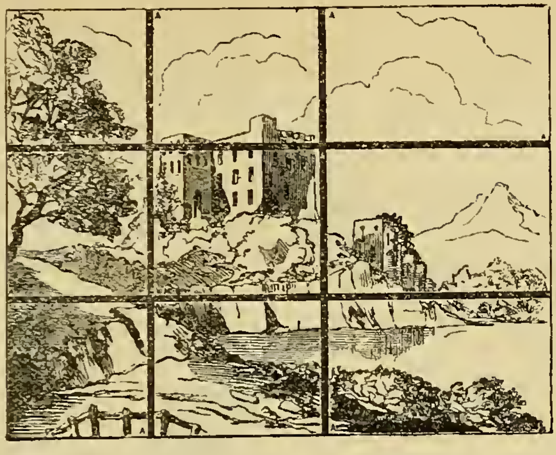


FIG. 51.—RUINS SCENE RULED WITH LINES FOR ENLARGEMENT.

As I previously mentioned, the foregoing plan is likely to be unfavourably received by experienced artists, as it tends to prevent freedom of the hand in sketching the picture on the cloth. To the experienced artist, therefore, I think the following system will be found sufficient for laying out his canvas. Having made the sketch design as in Fig. 51, divide it horizontally into three sections by ruling two lines, A A, with the pencil. Now consider which part of your design contains the most detail, which, in Fig. 51, happens to be the ruin

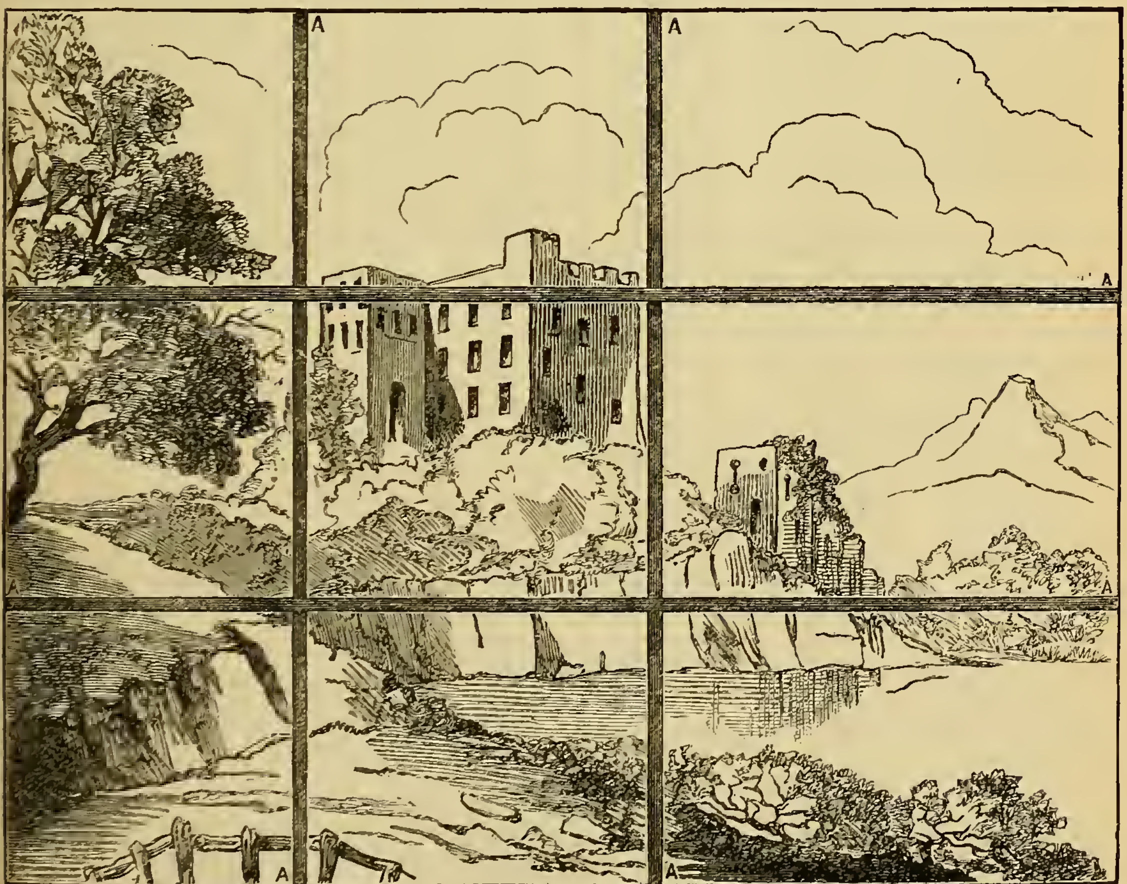


FIG. 53.—RUINS SCENE ENLARGED ON CANVAS BY MEANS OF TAPES.

in the centre and the large tree on the left, so that the ruin and the tree being the most difficult part of the picture to enlarge in proportion, we draw vertical guide lines, B B, to the right of each. Having our sketch prepared, which is an inch scale drawing (supposition only), the canvas is now laid out in this way: Instead of using the chalk line for "striking" the lines on the canvas, we procure some strong and wide black tape, cutting from it two lengths the width of the frame, and some three or four lengths as long as its height. These tapes may have feet and half-feet painted on them with white oil paint, and will be handy, thus prepared, in finding out the exact position they themselves are to be placed at on the "cloth." Now taking feet this time instead of inches, place the tapes with tacks on the cloth, making sure by measurement that they correspond with the lines we have ruled on the sketch.

We should now have on the canvas six divisions to guide us in laying out the principal part of the picture, increased from inches on the sketch to feet on the canvas, as in Fig. 53, where the canvas is shown laid out with the tapes, and the scene drawn in ready for painting. The tapes are shown at A A A, and the six divisions just referred to are the three on the left and three in the centre. The other three will also be found handy, excepting the top right-hand one, which is only a guide for the clouds being put in. It will, I think, be seen that the object of using tapes is, that they may be placed on any part of the cloth, and that when one portion of the picture is drawn, they may be removed to another part of the cloth, and a corresponding line ruled on the sketch. It is not necessary to confine oneself either to two vertical tape lines, as should the picture be full of detail, and difficult to lay out, three, four, and even more tapes may be used, so that it is advisable to make more than two. Two horizontal tapes will be found sufficient, however. Figs. 52 and 53 answer the two-fold purpose of illustrating my methods of laying out the canvas, also as suggestions enabling the novice to prepare scale drawings for an attic or a ruined abbey scene, and the advanced artist to paint from. Fig. 53 would do as a back cloth for the "abbey ruins'" scene in "New Men and Old Acres."

Whilst on the subject of designs and sketches for scenes, I might mention that the scene-painter may often find something good in this line amongst the cheap chromos and oleographs to be found at most picture dealers.

I had originally intended to give a list of designs in my possession, which comprise mostly sketches of original scenes from several successful productions, but I find it would take up too much space. Nevertheless, I shall be pleased to prepare drawings to scale, coloured or otherwise, at cost price; the only information I require being the size of scene, and for what play or opera it is wanted for, when I can in most cases furnish sketches from the original scenes.

(To be continued.)

THE ART OF PAINTING ON THE PHOTOGRAPHIC IMAGE.*

By JOSEPH HARRIS.

V.—TREATMENT OF BACKGROUNDS.

HE who would colour a photograph is in by far too many instances heavily handicapped. Not only has he to contend against those faults in expression, which photographers, as a body, are so prone to indulge in, but he has, in nine instances out of ten to create that most important part of all in the portrait—the background.

In the vast majority of photographic backgrounds the painter will find one all-pervading fault—they are overdone. The genius who produces these excrescences seems to consider it his especial duty to cover his sheet with as much picture, with as much subject, as he can possibly crowd into the space at his command. He has the opportunity of creating a landscape, and right well does he avail himself of the chance. Nothing is omitted: undergrowth in rankest luxuriance, tall trees, and a perfect forest of them, a winding stream, with bridge, rock, and waterfall; and in the distance our old friends the village church and the feudal castle, which always appear as if growing out of the sitter's head.

If the ground be an "interior," this same creative mind cannot rest with a delicate gradation of light and shade, and a faint indication of panel or dado, he must introduce his book-case crowded with volumes, the walls must be fairly divided into panels, by means

* It is due to the readers of AMATEUR WORK to explain that this series of articles was commenced in Vol. I., page 392, by Mr. JOSEPH WAKE, Head Artist to the Autotype Company, London. The second and third papers appeared in Vol. II., pages 78 and 308. The death of Mr. Joseph Wake rendered it necessary to make arrangements with another writer for the continuance of the papers, and his brother, Mr. A. J. Wake, offered to complete them. He contributed one article, the fourth of the series, which will be found in Vol. III., page 118, but, for some reason which remains unexplained to this day, he sent no more. The above paper, in continuation, is from the pen of Mr. JOSEPH HARRIS, and he will, without doubt, as far as his will is concerned, speedily bring them to a close. I append this note to show the difficulties that sometimes intervene to prevent the continuance of a series of articles that has been commenced under the best possible auspices.

of the crudest of lines, and the most outrageous attempts at "ornament;" he will give us the foliage in a conservatory, and in the distance we have the sashes of the greenhouse, which fit just over the sitter's head, and giving him the appearance of a caged animal, or a rival to the trade mark of the lion, the net, and the mouse, with nothing wanting to the imagination but the mouse.

In painting the photograph, the first object will be to obliterate as many as possible of these miscalled aids to pictorial effect. It is the portrait of the individual which is to be the subject, and as a consequence, the background must retire: it must compare with the figure, but in no case must it stand out in equal importance with that figure. There are some photographs at this moment being issued from one of the most noted *ateliers* in London, and the subjects are depicted lolling against the trunk of a silver ash tree, which shoots out of the top of the picture, devoid of leaf or branch, and presenting for our admiration a straight dark line, through the length of the photograph, varying in its monotony by a few patches of white.

If, by misfortune or chance, one of these abortions has to be painted, out with the trunk, and as the figure cannot stand upright without a lolling post, let it loll against some broken mass of rock, anything which will obliterate the perpendicular lines.

A grey tone may be made by an admixture of indigo and Indian red, adding white, if it be desired to render the colour opaque; if a more delicate grey be required use ultramarine, or French ultramarine and crimson lake with white optional. A very effective colour for most complexions is formed with indigo and yellow ochre, white at choice, according as the ground shall be transparent or opaque. When in doubt, always incline to neutral tints, using greys and greens for fair complexions, and olive or brown tints for dark people.

If the background be an interior, always gradate it so that the lighter portion shall be on the shadow side of the face, while the darker part throws out the light side of illuminations and tones down the lower portion of the figure; this will secure due prominence and effectiveness for its head, to which every touch must be subsidiary. Always obliterate every line in the background which can be dispensed with. Rely on a broad mass of light and shadow, and skilful management of the same by delicate gradation.

In my next paper, I hope to treat of draperies, foregrounds and accessories, and to show all amateurs who may desire to try their hand at colouring photographs, how these should be tinted and treated so as to produce the most telling effects.

(*To be continued*).

ETCHING ON COPPER.

By FRANK CHASEMORE.

I.—THE APPARATUS.

THE apparatus required by the etcher is very simple, and consists of the following articles: spirit lamp, hand vice, etching needles of different sizes, scraper, burnisher, two or three dabbers, camel-hair pencils, copper-plates, etching ground, small bottle of stopping-out varnish, bottle of nitric acid, two or three earthenware dishes or trays, Brunswick black, turpentine, bottle of copper-plate ink, polisher, fine glass-paper, emery powder, willow charcoal, wax taper, oil-stone, and graver.

The etching needles are used as pencils, to draw the design on the copper-plate through the ground. They are made in several sizes. Fig. 1 is a very useful form of handle, having a screw socket, allowing of the needles being changed. Common sewing needles do very well indeed for the points. Fig. 2 is another form of etching point, made out of a rat-tailed file, about 8 inches long, each end ground to a point, one end being coarser than the other, to enable the artist to draw fine or coarse lines without the inconvenience of changing the tool. These points will require frequent sharpening. The easiest way to do this is to place the side of the point on the stone, and to turn the handle round and round between the palms of the hands, at the same time pressing on the stone; this will give the needle a smooth round point, such that will not cramp the drawing. Fig. 3 is the scraper made with three edges, something like a three-square file, as shown in the section. It must be kept quite sharp, with a smooth edge. It is used to take out false lines, and to reduce lines that are too deeply bitten by the acid. It is held in the same manner as a penknife in scratching out ink marks from paper, but the edges must be nearly flat on the plate or it will cut too deeply. Fig. 4 is the burnisher, oval in section, used to burnish up the plate after scraping, and is also used to reduce coarse lines to finer, by pressing the edges down. Fig. 5 is one of the pads, or dabbers, made of cotton wool rolled into a ball and covered with silk, and tied round with twine to form a handle. The silk must not be ribbed, but of a fine smooth and even texture. These dabbers are used to distribute the ground evenly over the plate, and, if the ribbed silk was used to cover them, would give the ground a grained surface instead of the desired smooth one. Fig. 6 is a plate polisher, used for polishing up the plate with fine jeweller's rouge. It is made up by covering one end of a large cork with fine kid and tying it on with twine. Fig. 7 is the

taper twisted into a sort of rope. This is used to blacken the surface of the etching ground after it has been laid on, so that the design may be drawn on the plate, and also so that the lines drawn in the copper by the passage of the needle will show up clearly.

FIG. 1.—HANDLE FOR ETCHING NEEDLE.

The etching ground is made up into balls and covered in silk, as shown in Fig. 8. Etching ground can be bought at all artists' colour shops, and is made of a mixture of white wax, asphaltum, and gum mastic, melted together in an earthen pot and afterwards rolled into balls. I give three receipts for ground, and the artist must choose for himself which he will use. For his guidance I will here remark that additional wax will make the ground softer and more suitable for cold weather, and that additional gum mastic has the contrary effect.

FIG. 2.—ETCHING POINTS MADE OUT OF RAT-TAIL FILE.

It is safer to have the ground too soft rather than too hard, as when the ground is too hard it is apt to chip and fly under the needle, and so might spoil the work. Hard ground is also more liable to be burned in the process of blackening over the flame of the taper. In making the ground care must be exercised not to let the composition get overheated, or it will be spoiled.

FIG. 3.—SCRAPER WITH THREE EDGES—A, SECTION.

No. 1 Ground.

White wax	... ...	30 parts.
Gum mastic	... ...	30 „
Asphaltum	... ...	15 „

No. 2 Ground.

White wax	... ...	30 „
Gum mastic	... ...	15 „
Asphaltum	... ...	15 „

No. 3 Ground.

White wax, 60 parts.
Asphaltum, 60 „
Gum mastic, 30 „

FIG. 4.—BURNISHER.

Before describing the process of etching, I would remind the reader that, although it is possible for me to teach him the mechanical part of the art, it is quite impossible for me to make him an artist. To be a good etcher, he must be a good draughtsman in black and white. The picture must be drawn on the copper with all the care and regard to effect and finish that is necessary in a well executed pen-and-ink drawing.

The primary requisite in etching being the copper plate, it will be necessary to say a few words on that most important item. These plates can be bought at all shops where artists' materials are sold, and vary in price, according to size, averaging about one penny per square inch. The usual sizes range from 3½ inches by 2½ inches to 8 inches by 6 inches, but larger plates can be got. I have seen some even as large as 2 feet 6 by 2 feet, but I would advise beginners to try their hands, at first, on small plates, otherwise they would find their first experiment rather costly. The surface must be quite smooth and flat, and free from scratches, as every mark will print when taking a proof.

Before laying the ground, the plate must be cleaned with turpentine and a little whiting, to free it from grease, after which it is to be polished with breadcrumbs. When quite clean, the etcher must be very careful not to touch the surface with his hands. The next proceeding is to fix the plate in the hand-vice, by one edge, placing a small piece of paper between the jaws of the vice and the surface of the plate, to prevent the latter being bruised by contact with the metal.

Before laying the ground, the plate must be warmed. Light the spirit lamp, and hold the back of the plate in the flame, moving it about until all parts of it are equally hot. You may know when the right degree of heat is attained by dropping a small quantity of water on the back of the plate, when it should just boil.

Next proceed to lay the ground. Place the covered ball on the hot plate, and the ground will melt and ooze out through the silk, and spread over the plate. Rub the ball over all parts of the plate. Next take the dabber and, after again warming the plate, proceed to dab all over it, to distribute the ground evenly and thinly, to make a smooth surface. During the laying on of the ground great care must be taken to avoid any dust or flue getting on to it.

When the ground is put on to your satisfaction,

light the taper rope, and, after having again warmed the plate, taking great care not to melt the ground, hold the plate face downwards over the flame, so that the tip of the flame only just touches the surface, and so that the smoke will spread over it, and become incorporated with the ground. The flame must not be allowed to rest at any one place, but be moved carefully all over the plate, to insure an even blackening, and not to burn the ground. Fig. 9 represents this operation. When black enough, place the plate on a table, face downwards, to protect it from dust, but with one edge resting on something to keep the surface from being rubbed by the table. Leave it till quite cold.

The next thing to be done is to get a drawing-board, and to fasten two strips of wood on the upper surface, one near each of the opposite sides. The copper plate is to be fastened to this board, face upwards. The best way to fasten the plate is by four small pieces of wood screwed to the board, and resting on the corners of the plate. The board can then be turned about for convenience of drawing.

The design to be etched must next be transferred to the blackened ground. This can be done in the ordinary way of transferring, by tracing paper and red chalk. The red lines will show up distinctly on the black ground. Care must be taken in transferring the design to the blackened surface not to break the ground.

The drawing may now be done on the copper by the use of the etching needles, using the finest points for the fine lines, and the coarser points for thick lines. Care must be taken that the point of the needle goes quite through the ground and scratches the copper, or the acid will not bite.

To avoid touching the surface of the ground, and thereby injuring it, a flat ruler can be placed over the plate resting on the two strips of wood, to form a rest for the hand. The drawing must be done carefully, and not hurriedly; mistakes should be stopped out and corrected as soon as noticed, or they may be forgotten, and will, of course, be bitten in by the acid. What is known as cross hatching should be avoided as much as possible. Fine lines should be close together; coarser lines further apart, according to the thickness.

Having completed the drawing to your satisfaction, cover the back, edges, and all exposed parts not intended to be acted on by the acid, with Brunswick black, and put the plate aside to let it get quite dry.

You may now mix your acid. Get a stoppered bottle holding about a quart, and put into it three-

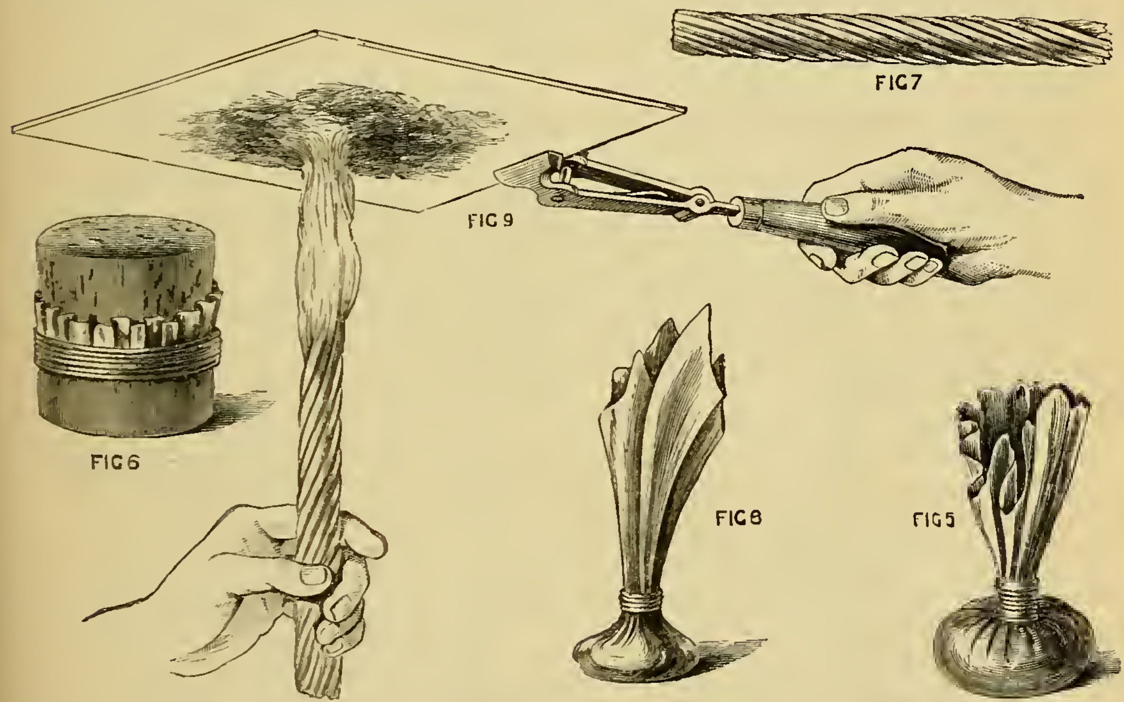


FIG. 5.—PAD OR DABBER. FIG. 6.—PLATE POLISHER. FIG. 7.—TAPER FOR BLACKENING SURFACE OF PLATE. FIG. 8.—ETCHING GROUND COVERED WITH SILK. FIG. 9.—METHOD OF BLACKENING PLATE WITH TAPER.

quarters of a pint of acid and fill up with water. Some etchers use a mixture of equal parts of acid and water; but I prefer the mixture as given above, as being rather slower in its action.

When the plate is quite dry, place it in one of the dishes that is just large enough for it, face upwards, and pour over it the acid mixture till it is covered to the depth of about a quarter of an inch. Now is the time of care and watching, to detect any false biting, which must be stopped out as it arises. The air-bubbles must be wiped off the plate with a feather or camel-hair pencil, as quickly as they are formed.

The plate must be left in the acid till all the finer lines are sufficiently bitten in, which will be in about five to seven minutes, according to the weather. The acid acts quicker in hot than in cold weather.

Now take out the plate and wash it under a tap, and let it dry, and stop out all the fine lines that are sufficiently bitten in, with stopping-out varnish, using a fine camel-hair pencil. When the varnish is dry, replace the plate in the acid and bite in the next finer lines, and remove the plate and stop out, and replace in the acid. Repeat this process till all the lines are sufficiently bitten in. The darkest lines will take from half to three-quarters of an hour according to the weather. Be very careful to stop out all lines requiring it at each stage of the biting, as if any are left they will appear too dark.

When the biting is finished, remove the plate, and work it well under a tap, and dry it carefully with a soft cloth.

The acid mixture must be replaced in the bottle and put away for future use. It can be used over and over again, only requiring a little acid to be added at intervals, as it becomes weakened by use.

The plate must now be cleaned with turpentine to remove the varnish and ground, after which it must be cleaned with an oiled rag, and polished with a soft duster, and is ready for taking a proof.

After taking a proof, clean the plate with turpentine and cover it with unblacked ground, and touch up any parts requiring strengthening, and rebite the plate, till a perfectly satisfactory impression is obtained.

Some etchers vary the process here described, by at first only drawing on the plate the coarser lines and biting them in; taking a proof, and then regrounding the plate, sketching in the next lines, and so on, taking a proof at each stage, till the fine lines are drawn. But I think the method I have given the best, but each can adopt the method that suits him best.

If any mistakes are made in the drawing, or any parts of the plate requiring alteration, the part must be erased and rebitten. To erase faulty parts, the exact spot of the fault must be marked on the back of the plate. The plate must then be placed, face downwards, on a sheet of lead, and the spot marked punched up with a small round-faced punch to raise a small pimple in the face of the plate. This pimple, which raises the faulty part above the general level of the plate, must be cut down with the scraper and polished with charcoal stump, and the part can then be re-etched.

In the next part of this paper I will describe the construction of my home-made printing press, and the method of taking proofs with it.

All the articles used in preparing the plate and laying the ground should be kept in a box, to protect them from dust, and should be put away directly after using.

Dust and flue, if mixed in the ground, will cause false biting, and the proof will look spotty.

The plate can be touched up, and very fine lines drawn, with the point of the etching needle only, no grounding and biting being necessary. This is called dry-point etching, and is very effective if done with judgment. The scratch of the needle raises a small burr on each edge of the line, which holds the ink. In the use of the dry-point, as in all the operations of etching, experience will be found to be the best teacher.

(To be continued.)

SCREENS: FOLDING AND OTHERWISE.

By J. W. GLEESON-WHITE.

II.—Suggestions for Arrangements in Monochrome — Coloured Scrap Screens — Christmas Card Screen — Postage Stamp Screen — Pictures on Wall Papers — Hand-Painted Screens — Materials Suitable for Screens.

THE ideas given in my first paper are for one treatment of the prints only. It may be as well to suggest some others before passing on to the coloured scrap side, although much that has been said applies equally to the coloured portion, yet the difficulty of obtaining a choice of these pictures and the greatly increased cost, combine to make that side very much less flexible and varied in its plan, and almost impossible to work out in any special design without a long time spent in special collection of the desired subjects, which would cost an infinite amount of money and patience, more than the result would justify in the majority of instances. But keeping to the monochrome side, a series of panels may be suggested.

A Portrait arrangement: the heads detached from the background, b entirely covering the screen,

arranged in a radiation from a given centre, such as an author's side, where Sbakspere might hold sway, while otber literary men of less calibre filled the space ; or female beauty, including portraits and ideal beads, might be arranged in somewhat similar plan. A Shakspere cbaracter panel would be of interest, or a favourite author might allow of a plan where, witb panels formed by lines of plain black paper, or made up of columns and strips from other pictures in a way seen on tbe old title pages of books, space could be found for portraits of his cbaracters, views of his house, or the scenes of the plot of his works, and even extracts from the works themselves either in print or neatly engrossed in a clear but decorative printing.

A Zoological Screen might be of use to the junior members of the household, and afford a pleasant pastime in the hunt for subjects, and endeavour to make each group of fauna complete in its arrangement, and variety of eacb known species illustrated.

Where it is desirable to use a series of pictures of one size or cbaracter, it is as well, I think, to emphasize the joints witb strips of black paper, and arrange tbem so as to form a rough pattern in themselves ; for example, a series of pictures from an ordinary octavo book might have the corners cut off and the diamond spaces so left between eacb filled by a head, either portrait or otherwise, the whole being marked out by black "leading," so to speak, and looking at a distance not unlike the wood-work of an old Chippendale glazed door in its arrangement.

A very pretty panel I saw in a screen was made up entirely of waterfall subject, so arranged with an occasional lake view, as to suggest one tumbling cascade over the whole panel, while various figures, kept to the scale of the whole and not to the scale of each picture, brought the complete design into harmony.

There is no reason why extracts cut from papers, or favourite verses culled from an odd number of a magazine, sbould not come between tbe pictures, as they afford amusement for an odd five minutes, and suggest topics of conversation when that much-needed article grows scarce; for when this happens, as unfortunately in our stolid English way it often does, and, the weather is exhausted, any topic comes as a godsend to afford some fresh talk.

When the pictures are pasted on and dry, a good coat of size should be given before the varnishing is done. Unless care has been taken in the black and white side to exclude so-called "toned" paper, or else to use it entirely, there is often a *stained* look about parts not pleasing. I fancy in such a case it would be best to wash a little weak coffee over the white parts before sizing. But I cannot speak from personal experience of the result ; but some such plan would no doubt obviate, or at least diminish, the defect I have named.

For many reasons the black and white treatment will often be found to repay the trouble more than the coloured pictures, perhaps because the choice is practically without limit, or more possibly because the neutral grey of the whole is less obtrusive, it will be found that a print screen tires less, and harmonizes better with the rest of the furniture. Personally I think a frame of black wood is best, and colour entirely excluded ; but the next best treatment is by the use of a dull claret velvet for the edges, or a dark crimson leather, but if colour is once added, the result is to give a poverty-stricken look to the prints which they did *not* possess before.

The "coloured picture" side may now be described, not dwelling on the ordinary medley arrangement, whether entirely covering the ground or showing a colour through. A very successful cheap decoration was obtained by using a series of toy-books, known as the Royal Illuminated Nursery Rhymes—first published some years ago, I believe, but now to be bought at a very reduced rate; until recently they were still to be had at Messrs. Oetzmann's—or a more recent series of Marcus Ward's would adapt in similar fashion. The smaller ones were united in a continuous frieze across the top of all the folds, a larger series made a dado at the foot ; they were pasted on entire, with the gold background, as printed. The other portion of the screen was covered with diagonal strips of olive green and grey-blue paper (see Fig. 1, page 16), while mediæval figures from a similar series of nursery tales, were cut out and grouped at random over the diagonal bands, shields, coats of arms, pots of flowers, and other small objects sprinkled among them—the whole very thinly covered with figures, not crowded as the usual way, made a screen, that has been painted in as a background by more than one artist of some note. Another had the same frieze and dado treatment, and any series of toy books would supply them equally well with those named, while a Japanese red paper was used for the filling of the panel (I mean a Japanese colour, the red of the lacquer, not a Japanese material). On this ground bold rushes and foliage were roughly painted with Bessemer or Judson's Gold Paint, the pictures cut in Japanese-like panels being grouped irregularly over the panel. As a variation of the same idea, blue paper with scraps formally arranged might be used, and a tiny running gold leaf, sketchily painted all over the blue surface showing between the pictures. Another way would be to take an olive green ground, and build up a conventional Old-China like tree, painting the trunk and branches, or cutting out brown paper to the required

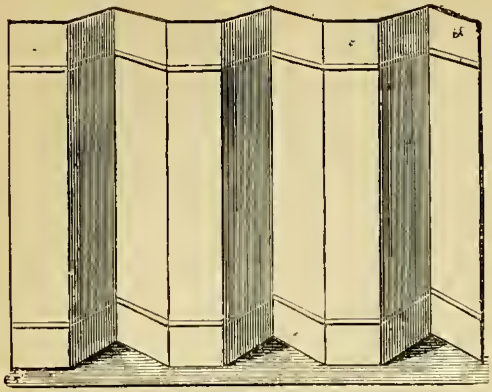


FIG. 4.—SCREEN WITH NINE FOLDS.

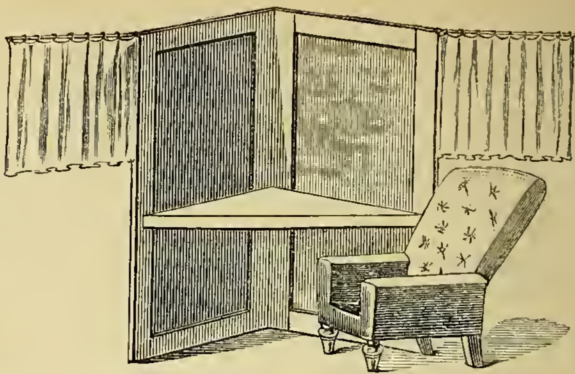


FIG. 5.—SCREEN MODIFIED TO CARRY SHELF FOR TABLE.

FIG. 6.—FOLD WITH GLASS PANEL.

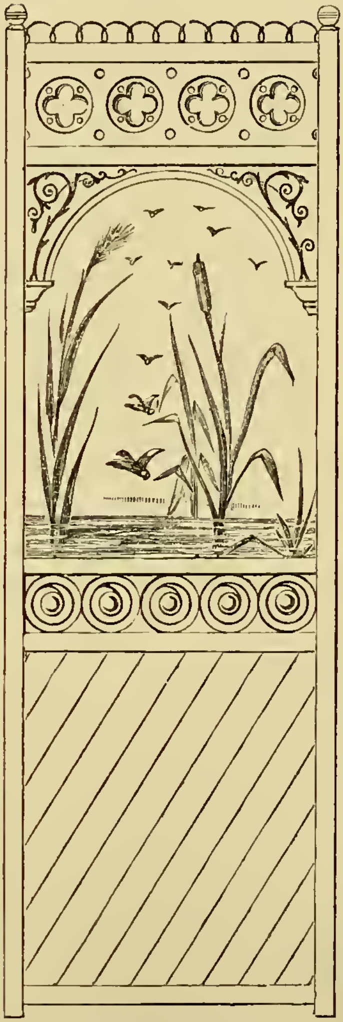


FIG. 7.—FOLD WITH PANELS OF GLASS AND WOOD.

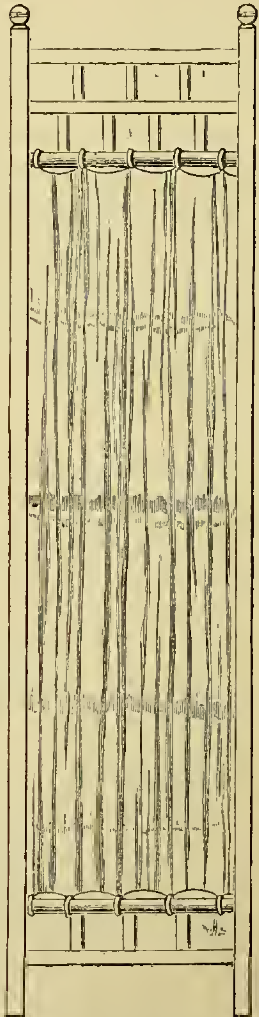


FIG. 8.—FOLD WITH CURTAIN FOR PANEL.

FIG. 9.—FOLD WITH PANEL OF MATTING.

FIG. 10.—TOP IN JAPANESE STYLE.

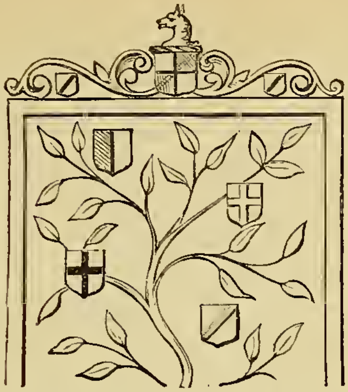


FIG. 11.—TOP IN HERALDIC STYLE.

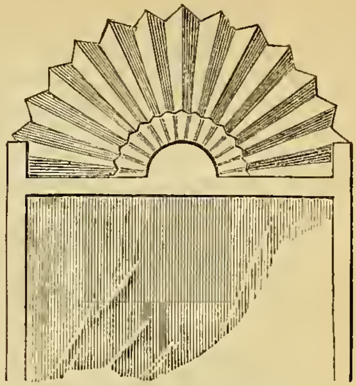


FIG. 12.—FANS MOUNTED AS TOP FOR SCREEN.

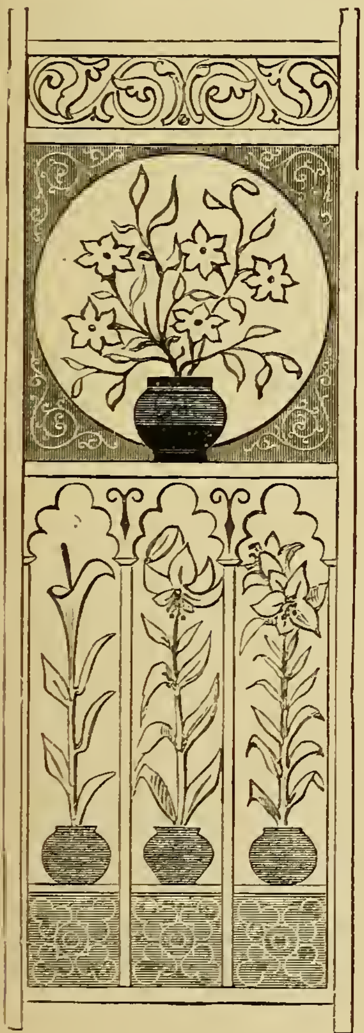


FIG. 13.—FOLD OF FRETWORK WITH PAINTED PANELS.

FIG. 14.—FOLD SHOWING PANEL COMBINED WITH LATTICE WORK.

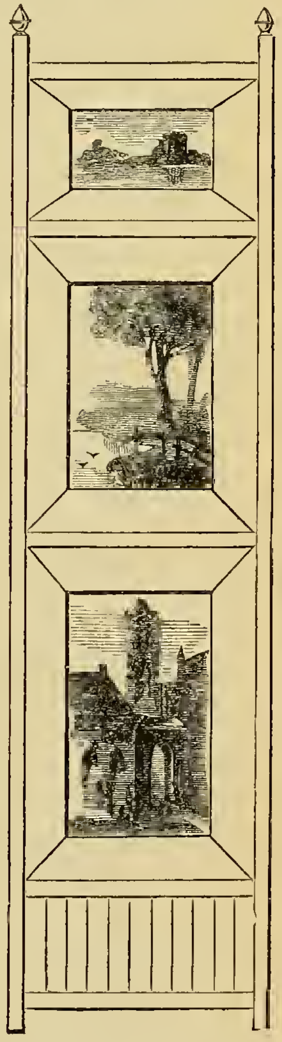


FIG. 15.—FOLD WITH MOUNTS FOR WATER-COLOUR DRAWINGS.

shape, while all sorts of flowers and leaves sprouted from them, and various objects were either hung Christmas-tree-like on the branches, or treated as medallions in frames of gold paint or paper.

But the arrangement of coloured pictures so entirely depends on the material available, that it is useless to take up further space with this branch of the work, although it is the most used and most likely to be used. In spite of so many just now, still almost any simple outline or lightly shaded print, if hand coloured, will, when varnished, look equally well with those originally printed in colour, and will afford additional occupation to the younger members of the family, in helping on the progress of the work.

The larger coloured supplements of the Christmas Numbers are often used as centre-pieces, but one rather wearies of the inevitable "Cinderella," or "Miss Muffett," knowing that nearly half a million of the same are doing decorative duty all over the world; and, personally, I would prefer a far less artistic picture to one so hackneyed as these subjects must necessarily become.

If buying scraps, children's toy books are better and cheaper than the so-called "Screen Scrap Pictures," as all the wonderfully artistic and clever designs of Walter Crane or Caldecott bought in this way average only a penny or twopence each, while a complete page of a single story may have the mottoes of the pictures either painted in gold decorative letters, or cut out and stuck on, adding to the effect; while if a poet forms part of the household, here may his rhythms find a graceful publicity, and help to decorate the home at the same time.

A Christmas Card Screen would be a happy way of utilising more pretty souvenirs of a friend's wishes for our happiness, and might be arranged with very pleasing effects; dried fern leaves or grass might be pressed and mounted among the cards, to break the formality of the constant rectangular forms.

A Foreign Postage Stamp Screen would display a collection to advantage, but at the same time, render it useless for the future, as once varnished, I know of no means to detach the scraps for other use. If arranged under glass this objection would vanish.

For a screen for schoolroom or nursery, where the interest of the decoration is more in the details than in the effect of the whole, many instructive prints and maps or diagrams might be used, and letters should take a prominent part; while as teaching through the eye is of such great importance, care should be taken to exclude badly drawn or vulgar pictures—that is, vulgar in colour or idea, as, of course, one would not put subjects of a coarse nature on any screen, but the pirate and comic policeman class of subjects should find no place on the nursery walls, nor do the bright gaudy chromos given as almanacs and advertisements have anything but an injurious effect on the young. Really good black and white is always available, while crude coarse colour is better avoided than used, although better cannot be had.

Another way will be found which is a compromise between the scrap screen and one covered in other material. For instance, choose a wall-paper with natural branches of some creeper, or floral design, treated in a free and unconventional manner, and such are by no means hard to meet with, and arrange cut-out birds and butterflies over it, thereby doing away with the mechanical appearance of printed work, at infinitely less expense and trouble than using scraps entirely, or painting the ground. If in place of a patterned wall-paper, a crêpe gold paper, or gilded American cloth is used, the effect would be very like hand-painted work, especially if some of the many excellently-printed designs for crewel work, or embroidery were cut out and skilfully arranged on it.

I knew a gentleman who had a quantity of prints, hand-coloured, life-size, from a rare book on natural history. These he cut out and mounted all over a wall paper. After some years, on leaving the house, he soaked them off and used them again, and once more changing his residence he took them with him, where they now decorate a frieze in one of his rooms. This is a hint that might lead to others adapting their loose pictures to permanent decoration, as I see no reason why a small room, if done in good taste, might not be decorated, screen fashion, with cut-out pictures, or with black and white, arranged as suggested previously.

Last, and not always best, comes hand-painted panels (so called in the art slang of the day, though surely the few artists who have attained celebrity by using their feet or mouth to hold the brushes, and work, from reasons imposed by nature, in an uncommon manner, are too few to be always borne in mind and excepted every time painting is mentioned, while if merely non-mechanical printed work is meant, painted cannot express any other way than the brush handiwork, as distinct from an impression or transfer); but it must be remembered that distinctly bad handiwork is not an artistic advance on good mechanical reproduction; what is bad in itself is not so much a question of neatness of detail, or skill in brushwork, nor even in choice of subject or colouring, as an idea-less, soul-less imitation of the worst faults of mechanism, which so many of the decorations on so-called hand-painted Christmas cards, leather goods, and ivory, so very often present. But conventional designs in the School of Art needlework kind—though one would be very sorry to approve of many issued with that imprimatur—and pleasing arrangements of natural foliage

and flowers will always be suitable for suggestions of arrangement. The celebrated Japanese design books now sold at the Oriental shops, or many a screen or crêpe picture will supply a hint of the exquisite arrangements by which the Japanese artist decorates without overcrowding, or, on the other hand, making a decorative panel into a picture, for the distinction is real, and necessary to be observed. A picture may so convey an idea of distance and light as to suggest, as it should, a peep through the frame, as through a window at another view, with its own conditions of light and atmosphere, while a decorative panel should not lose the idea of a flat surface, and at most like a Greek bas-relief, suggest distance or relief, and not appear to supply it nor contain lines or forms sufficiently prominent to confuse and spoil the lines of the actual work, which it professes to adorn, and not to merely use as framework to itself.

Before concluding, it will be as well to touch briefly on the other coverings and materials for a screen beside the scrap-covered canvas, that has taken up the main part of this paper. Of materials treated in a similar way some mention has been made, thus to merely recapitulate—Japanese gold leather paper, lincrusta (too heavy in effect, save for specially treated framework *in situ* of its designs as sold, but almost perfection in the crêpe form as a ground for painting), Indian matting, etc., would be a waste of space; but the ordinary fluted chintz, or silk curtains on rods, such as one sees in many a furniture display—are exceedingly good and useful from their lightness and warmth. These are generally made with turned rods, although square rods, treated as in Fig. 8, might be equally successful. The curtains should be made with plenty of material, to set in good folds, where privacy rather than draught is the object. The cheap Syrian curtains, costing about 1s. each, may be used, as they would not exclude the light—an important consideration for some rooms. In the screens shown in Figs. 7 and 15, glass is introduced. In Fig. 7 it is intended that glass, painted if possible, should be inserted in the upper panel, while thin wood, in diagonal slips, fills the lower one. Fretwork ornament is intended to fill the two friezes shown, also the spandrels of the arch. This should be lined to avoid draught. In Fig. 15, mounts of gilded wood or cardboard are inserted, to show water-colour drawings or engravings. This screen, though perhaps suggesting a public picture gallery, would be useful for a library or large dining-room. For these glazed screens the framework should be more solid than for the canvas-covered sort. It is as well to fix, at the end of the screen touching the wall, two brass hooks, that shall fasten into two eyelets of brass fixed in the wall, to avoid the risk of a sudden upset of the whole screen, which, if glazed, would be both annoying and positively dangerous from the falling glass.

In Fig. 5 is shown a screen with triangular flap that hooks the screen together, ensuring its stability and forming a useful shelf for books, while light, simple L-shaped rods, turning, support extra curtains. It might be easily arranged that the rods folded in and the shelf turned up flat inside the screen, so that it took up little room when out of use. Only two folds are shown, as the extra rods might have curtains full length, if more space is desired to be enclosed by the screen, or a pocket to hold newspapers might be added underneath the shelf.

Fig. 6 shows a more ornamental framework, with panels of leather paper or lincrusta below, and painted or needlework panel above, with simple pierced work or fretwork in the triangular openings. Fig. 9 has Indian matting for the lower half, and Byssophanie decoration for the panel. Fig. 4 shows a form varied by using extremely narrow folds, and a greater number of them.

Fig. 13 shows a more elaborate frame, with carving or fretwork freely used, and special panels, either of painted or needlework.

The framing in Fig. 14 might be left as open lattice, or the squares filled up as desired. It has light joinery of square rods in Japanese style at the top. The heads in Figs. 10 and 11 are of joinery and fretwork, Fig. 11 being for an heraldic screen, and only intended as a picture note, not as a design; the panels having genealogical trees, and the cresting being arranged with shields to carry coats of arms. Fig. 12 shows the possibility of fixing Japanese fans fully opened to form an arched top to each fold. If there are still any points left unnoticed that I can supply, the columns of correspondence are always open for that purpose, and I will do my best to make clear any abstruse point, or to suggest any other variation required.

The screen family has a collateral branch of cheval and other smaller species that I hope to talk over at a future time.

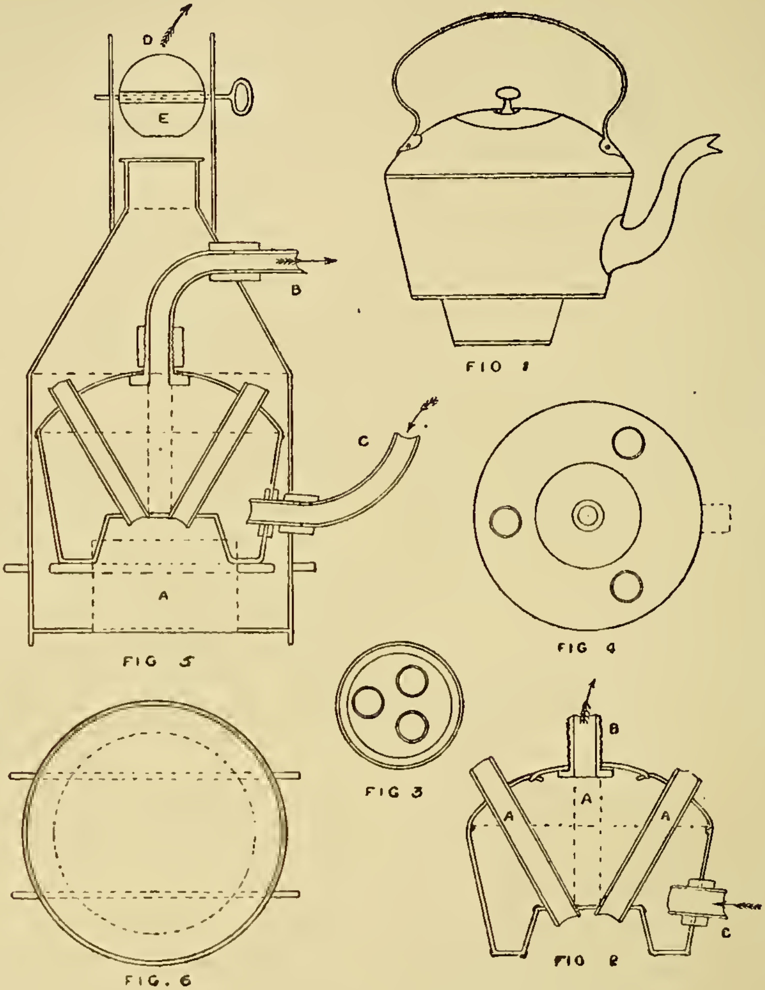
AN INEXPENSIVE GAS BOILER FOR HOT WATER HEATING.

By H. J. CREWE.

IT may not be out of place at this season of the year to again bring forward a subject which, no doubt, is exercising the minds of many amateurs who have greenhouses, and a desire to preserve their plants from the coming frosts and severe weather which may be shortly naturally expected. In the

number of AMATEUR WORK appearing for January, 1884, there was given a design and details of a very excellent boiler to be heated by gas for the purpose of hot water pipes, etc., but the intricate workmanship required to construct one on this principle placed it beyond the reach of any, but the most advanced of amateur mechanics. After weighing it over in my own mind at that time, I set about forming one after my own idea, and as it has turned out quite successful, I venture to place it before any amateurs who may be desirous of obtaining something of the sort themselves, and I am sure they will find the making of such a boiler very much easier than other kinds more generally in use.

In the first place, I obtained an ordinary block tin kitchener tea-kettle with a copper well and bottom, as in Fig. 1, which cost me about 5s., and held about five pints. I also purchased twenty-one inches of $1\frac{1}{4}$ inch copper tube, which I had cut into three pieces of equal length; this cost 2s. I then cut off the kettle spout and handle, and melted off the bottom and well. I then inverted the well, and soldered it into the bottom again. First, however, I ought to say, I cut three round holes $1\frac{3}{8}$ inch in diameter, and in position as shown in Fig. 3 in the well, and also three holes of similar size in the top of the kettle, as shown in Fig. 4. Through these holes were passed the copper tubes, the joints in the well being soldered in before the bottom was placed on. The hole where the spout had been was also filed round, and a piece of 1 inch iron pipe—ordinary gas barrel—screwed on the outer side, was placed in, and with a lead washer and a backnut with a little red and white lead in between, on either side formed the connector for the bend or pipe, called the return pipe. I next placed the bottom on the kettle with the tubes passing through the upper holes, and soldered all the joints, doing as much as possible on the inside through the lid opening. Next cutting the knob off the lid and making a hole, I placed a similar connector as that in the spout hole, taking care not to let it project internally more than just sufficient to take the backnut. Then soldering the lid in position my boiler was complete, as Fig. 2. The next thing required was a case to enclose it and retain the heat. This I made from an old five gallon iron oil drum with riveted joints which



INEXPENSIVE GAS BOILER FOR HOT WATER HEATING.

FIG. 1.—KETTLE BEFORE ALTERATION. FIG. 2.—KETTLE WITH BOTTOM INVERTED AND TUBES AND CONNECTIONS FITTED—A, A, A, Tubes; B, Connection for Flow Pipe; C, Connection for Return Pipe. FIG. 3.—PLAN OF WELL OF KETTLE, SHOWING HOLES CUT FOR TUBES. FIG. 4.—PLAN OF TOP OF KETTLE, SHOWING HOLES CUT FOR TUBES. FIG. 5.—BOILER IN CASE, COMPLETE—A, Opening for Gas Burner; B, Flow Pipe; C, Return Pipe; D, Pipe into Flue; E, Draught Regulator. FIG. 6.—PLAN SHOWING IRON RODS TO SUPPORT BOILER.

proved just the right shape and answered admirably. I cut the bottom entirely out of the drum, to get the boiler in position, then I cut the handle off, and made a 1½ inch hole, through which with a bend passed the upper or flow pipe from the boiler; another hole in the side at the proper distance answered for the return pipe, and the boiler itself was supported by two iron rods passing through the drum from side to side through holes punched for the purpose. A 3 inch flue pipe, with a simple turning regulator for the draught carried into the open air from the top of the drum, formed the chimney, and carried off the burnt fumes, etc. A portion of the side of the drum, about 4½ inches wide and 3½ inches high, was cut out to admit the burner, which was one of Fletcher's drip proof star burners, as Fig. 7, connected with an india-rubber tube to the gas pipe, and the whole thing was completed, and as shown in sections, Figs. 5 and 6. It answered admirably from the first, and I never had the slightest trouble with it, the consumption of gas never exceeding (after regulating supply) 10 feet to 12 feet an hour, and the coil heated containing about 30 feet of 2 inch pipes.

It took me about ten evenings altogether to do the work and fitting, and the gratifying result well repaid me for the trouble taken, the cost of all the materials including connectors, but not pipes, was about 12s.; and I feel sure that any amateur following the same plan cannot fail to obtain an equally satisfactory result.

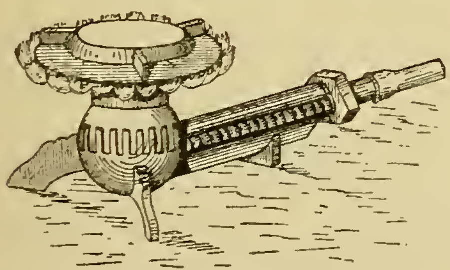


FIG. 7.—DRIP-PROOF STAR BURNER FOR GAS BOILER. (*Patent of T. Fletcher, Warrington.*)

HOW TO CONSTRUCT A SIX-INCH WOODEN LATHE.

By OLLA PODRIDA.

VI.—DETAILS OF METAL WORK WITH PRICES AND SUGGESTIONS—CONCLUSION.

ACCORDING to promise, the metal work will now be taken in detail, and the price of each separate part given with suggestions for makeshifts as may seem suitable, so that the information upon the subject may be as complete as possible in the endeavour to minimise difficulty to the amateur. Through the courtesy of the Britannia Company, of *Colchester*, the writer is enabled to give these prices, which, it may be added, are most reasonable, considering that the possibility of a large demand arising is merely speculative. On the quality of this company's work it is unnecessary to make any remark. It is all that can be desired, and the natural outcome of good system and supervision. As is well known, this firm, in addition to their ordinary work for the trade, makes a special study of, and pays particular attention to the requirements of amateurs, and other users of light labour-saving machines.

They are prepared to supply any single detail at the price quoted, so that intending lathe-builders may thus have the privilege of purchasing such parts only as they require, and be under no obligation to pay for other details which they themselves are able to make or otherwise procure.

We may now proceed with particulars of the details, commencing with the

Mandrels.—Of these, three types have been given, two of which are recommended as being most serviceable, from different points of view.

The first of these is that with the conical and plain bearings, as shown in Fig. 4 in the Folding Sheet to this subject in Part 44, for July—and also drawn in detail in Fig. 29, page 525, Vol. IV. This form is recommended for stiffness and durability, but it is more expensive than the alternative arrangement given in Fig. 8, in the Folding Sheet—the latter form, although primitively simple and unpretending, being very serviceable and capable of executing a great deal of work if properly looked after.

The price of the first mentioned, made of steel and finished complete with locknuts, will be 12s.

The brass bushes or bearings, Figs. 21 and 22, page 481, belonging thereto, may be obtained bored to fit, faced, turned, and holes drilled and countersunk for wood screws, complete for 6s. 6d.

The second, or alternative form of mandrel, may be obtained in steel for 8s.

The screwed collar, shown in Fig. 26, page 525, for chuck to shoulder against, will cost 1s. finished, and the brass thrust-plate, Fig. 25, page 525, will cost 1s. 6d. complete, with centre hole bored, and holes drilled and countersunk for wood screws. But this may be made by the amateur himself, provided he can obtain a piece of sheet brass, or even iron, about ⅛ inch thick.

The tail-pin, threaded and locknut fitted complete, will cost 2s. This price applies also to the tail-pin for No. 1 mandrel.

Tail-pin Bracket.—This is only required for No. 1. It will be made of wrought iron, and supplied

with hole tapped for tail-pin, and holes drilled and countersunk for wood screws, for 1s. 6d.

Cheek Plates for Cone Pulley.—These are two in number, made of wrought iron. They are given in detail in Fig. 33, page 524, and also marked *p* in Fig. 4 in Folding Sheet. The price of these complete, with centre holes bored, holes for wood screws drilled and countersunk, key way cut and gib-headed key provided, will be 2s., the key costing 6d.

Cheek Plates for Flywheel.—These are also two in number, as given in detail in Fig. 35, page 584. The price of these complete with centre holes bored, bolt holes drilled, key ways cut and two gib-headed keys provided, will be 3s.

Crank Shaft Centres.—These consist of plate nuts, two in number, shown in Fig. 17, page 481, and steel centre pointed screws, shown in Fig. 18 in the same page. The price of the plates complete will be 1s. 6d., and of the screws 3s. 6d.

Crank Shaft.—The price of this finished, with centres drilled up and "dip" or cranked part turned, will be 11s.

Treadle Hinges.—These should be of a long pattern, and as stout as can be obtained. They may be purchased at any ironmonger's shop at an outlay of about 2s., or even less, the price varying with the length and weight.

Poppit Screw.—The price of this with steel point, and fitted with vice handle, as shown in Fig. 60, page 25, will be 7s. 6d. If desired, it will be fitted with a hand wheel instead, and will then cost an additional 6d.

Gun Metal Nuts for Poppit Screw.—These, if two are desired, will be provided fitted to the poppit screw, and with holes drilled and countersunk for wood screws, as shown in Fig. 58, page 25, at a cost of 4s. 6d. A single one will cost 2s. 6d.

Hand-Rest with T.—A hand-rest to suit with one T for wood turning will be supplied for 8s. 6d. If a foundry is near, the amateur by making his own pattern according to instructions given, may obtain one at a cheaper rate, providing that he doesn't value his own time. A holding-down bolt and plate for this rest will be supplied for 1s. 6d.

Fly Nuts for Poppit Head and T-*rest.*—Details of these nuts, which are alike, are given in Fig. 64, page 25. They will be supplied ready tapped and fitted to the bolts for 3s. 6d.

Holding-down Bolt or Stud for Poppit.—This detail is given in Fig. 65, page 25, and will be supplied with ends screwed for 9d. The screwed head fitting into the poppit, as shown in side elevation of the latter at Fig. 56, in the same page, and in detail in Fig. 59, will cost 6d., ready tapped to suit end of bolt or stud.

Bolts, Nuts, and Washers for Framing, etc.—For fixing sides of bed to uprights, and securing front part of the headstock to bed, five $\frac{3}{8}$ inch bolts, $6\frac{3}{4}$ inches long are required, and will be supplied with nuts and washers complete for 1s. 6d. For bolting the front part of the headstock, liner, and back part, or upright together, two $\frac{3}{8}$ inch bolts $9\frac{1}{4}$ inches long are required. These will cost, with nuts and washers complete, 1s. For securing the arms of the fly-wheel at the centre with the cheek plates, four $\frac{1}{4}$ inch bolts 3 inches long are required, and will also cost with nuts and washers, 1s.

Iron Flywheel.—If an iron fly-wheel is desired, prices of the same for two different sizes are given for convenience; one 24 in. in diameter, turned, speeded, and bored, will cost £1 12s. 6d. The same description of wheel, but 27 inches in diameter, will cost £2 5s.

Iron Cone Pulley for Headstock.—An iron cone pulley of suitable size, turned, bright, speeded, and bored to mandrel, will cost 11s. It will, however, be unnecessary to go to the expense of an iron cone pulley, as a wooden one will answer quite as well for all practical purposes. In the case of the fly-wheel, an iron one would certainly be better as regards weight, which is, of course, the main thing, but the experience of the writer goes to prove that a great deal may be done with a wooden one without inconvenience to the operator. If heavy wood cannot be procured for the making of the room, it may be supplemented with strips of lead tacked or screwed on to the side.

It is my hope that these papers may be of assistance to some at least of our readers who are desirous of possessing a substantial lathe in a comparatively cheap form. I have no hesitation in stating that those undertaking the construction of such will find themselves amply repaid for their trouble; and if assistance is afforded from the foregoing, it will be satisfaction to know that my labour has not been in vain. I have endeavoured to make the instructions clear and detailed as far as time and space would allow, but if difficulty is experienced by anyone in interpretation of detail or method of procedure, I shall be most ready and willing to give further help through the medium of "Amateurs in Council."

HANDY WORK IN FARM AND GARDEN.

By GEORGE EDWINSON.

XI.—DITCHING, DRAINING, AND IRRIGATING LAND.

WHEN marshes and other wet lands have been partially dried by means of open furrows and ditches, they may be further improved by a system of underground drains, and these be made to supersede all the open drains except the canals and main

ditches. The wet land on each side of ditches may be drained at once by means of underground drains without resorting to the use of furrows. Underground drains may also be employed to improve wet patches of land situated at a distance from rivers and marshes, and such wet patches are not uncommon on elevated ground such as a hill side with peaty or clay surface soil. A section of such hill would show it to be composed of layers or strata of rock, chalk, stones, sand, and clay arranged in basins as shown in the sketch at Fig. 127. Here it will be seen that the hill was built up in primeval times of alternate beds of clay and gravel depressed in the centre as if pressed down until the edges of each basin turned up at the surface. All rain falling on the crown of such a hill will sink down through the sandy loam and gravel until it reaches the first basin of impermeable clay, where it will be detained until it fills the basin with water, and forms a water table. As this overflows at the edges it forms land springs, and keeps the contiguous clay or peat soil perpetually wet. It happens, sometimes, that the upper basin of clay is leaky, and the water finds its way by numerous small fissures to the next layer of gravel where it is again detained by a lower basin of clay; this in turn fills, and overflows at the edges, and, being fed from the upper water table, discharges its water in the form of more permanent land springs which continue to flow whilst any water remains in the upper water table. In draining such a piece of land, the drains must be made to cut through each layer of clay, and be continued into the upper water table as shown in the sketch. It may also be necessary to run several such drains into the upper basin if the wet patch is extensive, because such basins are sometimes of irregular form, and are divided by bands of impermeable clay. Marsh land, and land showing water on the surface, will clearly indicate the need of some system of drainage; but water-logged soil is not always so clearly indicated. The owner or occupier only knows that his land is not productive. His harvest is always late on certain parts of his farm; the cattle are never healthy when pastured there—sheep get the foot rot, and larger cattle get various gross humorous swellings. Other signs of wet land needing drainage, are as follows: The land is heavy, and turns up in close clods from the plough or spade; rushes, foxtail and other semi-aquatic plants, show themselves here and there; hoof marks of cattle remain deeply imprinted in the soil even in dry weather; grass and wheat crops retain their wintry green tint long after those on other lands begin to show the lighter and more mellow green tints of spring; roots grow spindle shaped, and are small; and snow remains on such land long after it has melted elsewhere. All such signs as these clearly indicate that the land is wet and cold, and needs thorough draining by a system of underground drains. Furrowed surface drains and ridges would be useless on such lands as these, because we must tap the water-bearing strata and source of springs beneath the surface, and thus prevent the water from rising up through the land. Farmers and gardeners should always remember that water, to be useful to plants, must be mixed with air, and must pass down to their roots through the soil. This leads us to consider the necessity of a system of underground drainage.

Underground Drains.—In my last article on this subject, I mentioned one system of underground drains by means of poles and brushwood thrown into the bottom of trenches and buried there. I learn from older and more experienced drainers, that such systems of drainage has been lasting and effective for long periods, but I cannot recommend them where permanency is desired, since it is only reasonable to suppose that the time will come when the poles will rot and the fine soil choke the water channels. A similar objection may be raised against the use of rough stones promiscuously thrown into trenches, since the irregular water channels between them are equally liable to be filled up with fine soil. This objection does not apply to the drainage of peat soil and bogs, for it has been demonstrated by experience that such wet land is best drained by such methods at first, until the surface has sunk and settled down to a permanent level, when more permanent drains may be constructed.

Temporary underground drains in peat, resting on a subsoil of clay, may he made entirely with the material on the land itself in the following manner:—

Dig trenches, 2½ feet deep and 20 feet apart, along the line of the greatest slope of the ground. Form the bottom of each trench, as shown at Fig. 128; that is, make a narrow water channel by means of a narrow-bladed grafting tool at the bottom of the trench, and cover this with thick sods of peat resting on the clay shoulders of the channel. Over these, place a layer of brushwood, and on this place a layer of straw or dry grass, then fill up the trench with the peaty soil. The straw and brushwood will cake together in the clay soil, and form a hard cover with the peat as it decays, whilst the water channel will remain intact for several years. The best permanent drains for all soils are those constructed with water channels of stone, or of drain-pipes, or tiles. Stone water channels may be employed in soils where the subsoil is a band of clay resting on chalk, gravel or rock, and where suitable stones can be readily obtained. In such lands as these, the clay subsoil is merely a thin strata of from 2 to 4 feet in thickness, and this crops up to the surface here and there, form-

ing beneath the soil, pools of stagnant water. If we can cut down through this band of clay, and run the bottom of the drain on the hard material beneath, forming the channel with stones, an excellent permanent drain can be constructed. Such stones as slate, ragstone, sandstone, and limestone, or others capable of cleavage into slabs for the covers of the drain, may be used for this purpose. Overburnt bricks may also be used with advantage, instead of stone. Drains with stone water channels are taken out wider than those for drain-pipes, and the sides of the drains are more perpendicular. The bottom of the drain should not be less than 18 inches in width, and it should be made level and firm before building up the stone walls of the channel. The walls are constructed of thin stones, laid regularly upon each other to a height of 6 or 8 inches, leaving a channel of some 6 or 8 inches wide between them; this channel is spanned by covers or slabs of stone, on these is thrown stones and any rubbish obtainable, including roots of trees, stumps, brushwood, hedge parings, etc., and then the trench is filled up with the excavated subsoil and soil. Some drainers use the slabs only, set against each other to form a saddle or pointed arch; but these are apt to slip under the lateral pressure of the soil, and cause a collapse of the water channel. Where roofing or ridge tiles are obtainable, these are sometimes used as a substitute both for stones and for drain-pipes, in the following manner: The bottom of the drain is floored with flat tiles, on these is built a low wall of broken tiles, and the channel is spanned with ridge tiles. If these last are strong and well made, a very effective and permanent drain can be thus constructed, since the surrounding water can percolate through the many crevices at the sides, and through the floor of the drain, and also between the edges of the ridge tiles. Unless such drains rest on a hard bottom, such as rock, or chalk and gravel, there always exists a danger of stoppage at some time, from one or other, or all of the following causes: Subsidence of the ground beneath, and consequent breaks in the level of the water channel; infiltration of soil, and silting up of the channel with sand from the upper parts of the drain floor; occupation by moles and similar burrowing animals, in dry seasons; and, when constructed near trees, filling up of the channel with roots. To avoid such dangers as these, and ensure at all times a permanent water channel in clay soils, it is best to use drainpipes specially made for the purpose. These pipes are tubes of baked clay, from 2 to 6 inches or more in diameter, and from 12 to 15 inches in length. They are obtainable in England at most potteries and through all dealers in builders' materials, at prices ranging from 10s. to 15s. per thousand. For all general purposes the plain tube or straight drain-pipe should be used, and merely laid with the sections end to end in a straight line. Where probable intrusion of roots is suspected, it will be advisable to use collars made of short sections of a larger pipe, over the joints of the pipes. If socketed pipes are used, the amateur drainer must bear in mind the ultimate aim

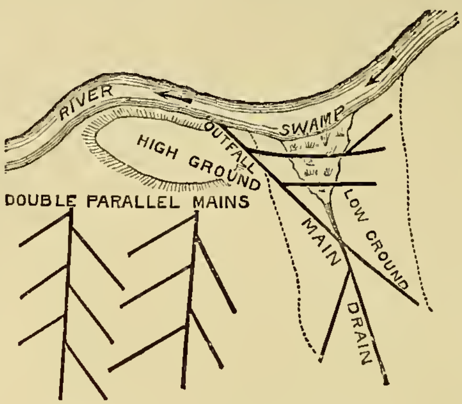


FIG. 138.—PLAN OF MAIN AND LATERAL DRAINS.

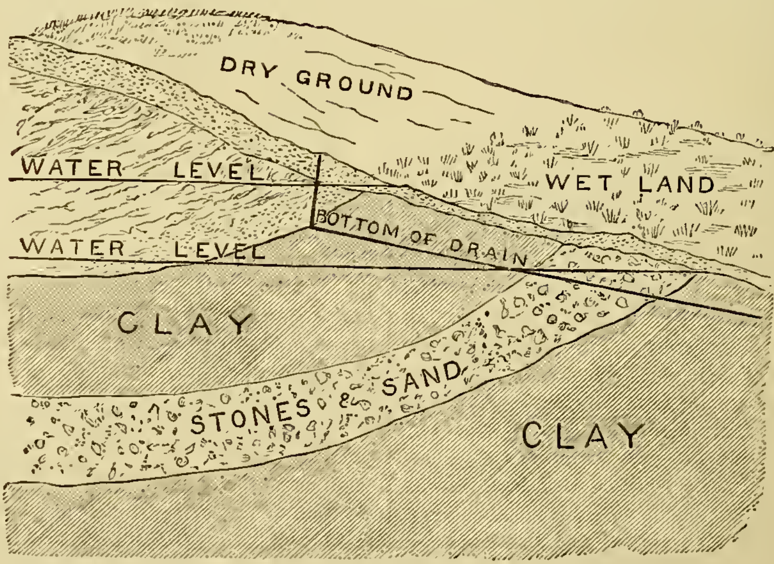


FIG. 127.—SECTION OF HILL SHOWING CAUSE OF WATERLOGGED SOIL ON UPLANDS.

of his work, and avoid the mistake of jointing the pipes so closely as to exclude water, because, in using pipes for draining, each joint acts as an inlet to the channel inside, and must therefore be left loose. When socketed pipes are used in drains for sanitary purposes, the opposite course must be taken, and the joints made perfectly water and gas-tight with tempered clay and cement, and the same precaution must of course be taken when such pipes are used as water channels from ponds or wells, and at the junctions of branch drains with the main.

It will be seen from plans accompanying this article that all lateral drains are made to enter the main drain obliquely, in a direction with the current of water. This must be observed as a rule, and in ordering drain-pipes it will be necessary to specify the number of junction sockets required to make lateral connections; and these parts will indicate the angle at which the lateral branches should be run.

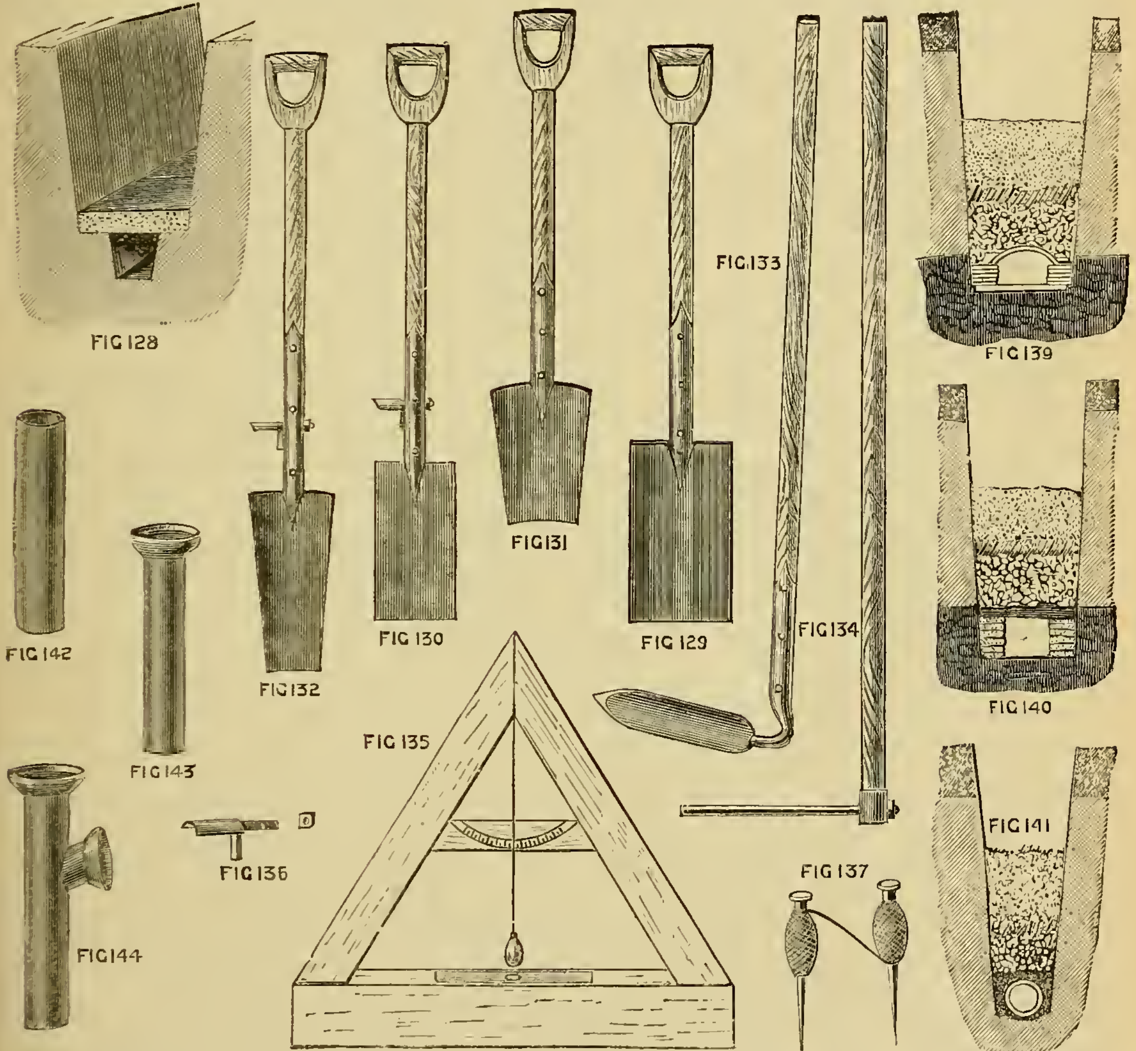


FIG. 128.—BOTTOM OF DRAIN IN PEAT AND CLAY. FIG. 129.—SPADE. FIG 130.—GRAFTING TOOL. FIG. 131.—SHORT-BLADED DRAINING TOOL. FIG. 132.—LONG-BLADED DRAINING TOOL. FIG. 133.—SWAN-NECKED SCOOP. FIG. 134.—PIPE LAYER. FIG. 135.—COMBINED LEVEL, PLUMMET, AND SPIRIT LEVEL. FIG. 136.—IRON TREAD FOR DRAINING TOOLS. FIG. 137.—LINE ON IRON PINS. FIG. 139.—TILE DRAIN. FIG. 140.—STONE DRAIN. FIG. 141.—PIPE DRAIN. FIG. 142.—PLAIN DRAIN PIPE. FIG. 143.—SOCKETED DRAIN PIPE. FIG. 144.—JUNCTION SOCKET.

The tool equired for draining will vary with the style of drain chosen. The trenches for stone drains can be dug with pick and spade, or shovel, and the workman will only need such simple tools together with accessories, such as a line, a straightedge and spirit

level, and a hedger's hammer. Trenches for pipe draining, could, of course, be dug with the same tools, but as an economy of labour can be effected by specially formed trenches only suitable to this method of drainage, a special set of tools is needed to make the trenches. The top, or fertile soil, to a width of two feet, is removed with an ordinary spade or short handled shovel, Fig. 129, and is cast up on the left side of the main drain, or the opposite side to that which is intended for the subsoil. The next spit of ground is removed with a grafting tool, or with a short bladed draining tool, Fig. 130 or Fig. 131, and this soil is cast over the right shoulder of the workman, as he works with his face to the outfall. The next and lowest spit is taken out with a narrower and longer bladed draining tool, shown at Fig. 132, and the remaining lumps or crumbs at the bottom of the drain are scooped up with the swan-necked draining tool shown at Fig. 133. By the use of such tools as these the sides of the trench gradually taper down until at the bottom there is only room enough for the drain-pipes to rest on a rounded floor, prepared for them by the semi-circular back of the scoop. In extensive draining works, it is usual to employ three men at the work. The first man marks out the drain and removes the surface soil, the next takes out the first spit of clay, and the third bottoms the drain, and in this way the men follow each other along the line of drainage. The work of bottoming is very arduous, because the strain on the workman's loins is great when he lifts the heavy lumps of clay from the drain beneath him and tosses them over his shoulder, for the trench is too narrow at the bottom to allow him standing room there. By the use of the iron tread (Fig. 136) attached to the handle of the draining tools, the workman is enabled to drive the tools deeper into the clay and take a deeper spit of clay. The pipes are laid by means of another tool, named a pipe layer, shown at Fig. 134. This is merely a long handle fitted with a transverse rod of iron at one end. The workman thrusts this transverse rod into a section of pipe and lowers it down into its place as the work of excavation is completed. If the slope of the land to be drained is readily apparent to the eye, such accessories as straightedges and spirit levels will not be required, but in most cases a useful combination of the level, plummet, and spirit level fixed on a straightedge will be a welcome addition to the drainer's tools. I give a sketch of such a tool at Fig. 135, from which it will be seen that it can be easily constructed by an amateur carpenter. The straightedge forming the foot of the tool, should be 3 feet in length by 6 inches in breadth, and with a thickness of 1½ inches. The A part may be made of lighter wood, say 4 inches by ¾ inch, and the height of the tool should be 3 feet 6 inches. Two other accessories useful in this work are a good measuring tape, and 100 feet of stout line wound on pins, as shown Fig. 137.

The first practical part of the work will be to survey the wet land and plan the drains. A small patch of garden ground may only require one main drain or two short parallel drains. A more extensive piece of ground may require a main drain with several short lateral drains. Larger tracks of wet land with an abundance of water, may require two main parallel drains together with several lateral branches, as shown on the plan Fig. 138. If the land is flat, it will be advisable to provide two parallel mains instead of one main, liable to be gorged with water in wet seasons. The direction of the mains should be in a line with the lowest depression of surface, and the lateral drains should follow the lines of the greatest slope. Where little or no slope is perceptible to the eye, and the A level shows the ground to be flat, or nearly so, a fall must be given to the drain artificially by constructing the outfall as low down as circumstances will permit, and gradually sloping the bottom of the drain from this point to its upper end. As a guide to determine the necessary fall, Professor Wrightson has laid it down as a rule, that "one yard in 220 is an ample fall;" but bearing in mind the fact that drains with a more rapid fall, keep their course clear for longer periods than those with a sluggish fall, I should recommend that the fall of drains be arranged as much above that of the Professor's rule as circumstances will permit.* If parallel mains are required, they should not be more than 200 yards apart, and the lateral drains should be not more than 30 feet apart in ordinary clay soil. No hard and fast rule, however, can be laid down to regulate the planning of lateral drains, since these must be conformed to the nature of the ground. The direction chosen should be marked out with wood pegs, driven into the ground along the route. In planning an outfall for the main drain, it will be necessary to avoid discharging the water into a neighbour's rights without his permission, and avoid polluting or unduly augmenting any stream, of which he has a beneficial use. When the outfall must enter a running stream or ditch, choose a firm part of the bank rather than a low swampy site, and cause the mouth of the drain to enter the stream obliquely with the current, but never at right angles to it. If no outfall can be secured in a stream, river, or ditch, it may be necessary to dig a pit or other reservoir for the water. If a bed of stones, gravel, or sand, is near at hand, the main drain can be made to discharge its water into such a bed beneath the surface.

* ¼ inch per yard, or 1 inch in every 12 feet, would give a good fall, and could be easily estimated by an amateur.

The work of excavation should commence at the outfall. If it is found necessary to have the outfall below the surface of a running stream, as in a river, or beneath the surface of a pond, and it is most likely that it will have to be constructed in such a position, then, a coffer-dam must be made around the mouth of the outfall, as recommended in my last to protect the workmen whilst building a culvert. After the coffer-dam has been built, the water and mud must be got out, and a gap dug in the bank to the required depth fully 2 feet in width at the bottom. In this gap, build up a solid wall of masonry or brick-work around one of the drain-pipes as a core. This block of masonry should be 18 inches square. First lay a foundation one brick thick; on this lay the drain-pipe and build around it. At the land end of the pipe build in an iron grating or some bars of iron in lieu of a grating; to these bars put the end of the next pipe, and build in both pipes together with the grating. This grating is intended for the double purpose of preventing any rubbish from floating up from the river into the drain, and also to prevent small animals from seeking a refuge therein.

If the drain is to be built of stone or bricks, without pipes, the outfall can be similarly constructed in masonry or brickwork, and the grating built into it 1 foot back from the mouth of the outfall. The masonry or brickwork can be carried up to the top of the bank if deemed desirable, but this is not usually done, because it is not necessary except in positions where heavy floods and a brisk scour of water is expected. It is generally sufficient to build up the gap with loose stones and turf, or with clay alone, as the trench is being filled in after the pipes are laid.

The outfall having been secured, the workmen stand with their faces to the outfall, and dig out the trench as before directed, down to the required level. This is tested at every few feet by means of the A level to ensure the right fall being given throughout the drain. The pipes are then laid as the work proceeds, and each section is firmly embedded to the required level in the channel prepared for it by the swan-necked scoop. As the pipes are laid, their joints are covered with the loose stones taken out of the soil whilst digging the trench, or a quantity of such rubbish as loose stones, brickbats, broken crockery, etc., is brought to the drain, and thrown into it to the depth of a foot or more before the clay is thrown into the trench. As the last pipe for the day is being laid, stuff a wisp of straw or hay into the opening to prevent ingress of any animal during the time the workmen are away from the work. The same precaution must be taken with the openings of elbow joints left to be connected to the lateral drains. These must also be left inclined upward to give a fall of at least 3 inches from the lateral drain into the main. The lateral or branch drains should be constructed to keep pace with the main drain, and these may deviate from the plan marked out on the surface if a necessity arises for such a deviation, such necessity being a change in the nature of the soil. In some localities it has been found necessary to turn the drain aside from the line marked on the plan for the purpose of cutting through bars of clay, or following the course of water-bearing strata. Little deviation should be allowed from the determined fall except for some good reason, and in no case must the bottom of the drain fall below the level of its inlet into the main. The last pipes in all the drains should be stopped with a large stone or a lump of bricks at the mouth of each, and when all the pipes have been thus secured, proceed to fill in the trenches, first with loose rubbish, then with clay, and finally with the good soil; this last may be heaped up in a ridge on the top, for it will gradually sink as the clay and rubbish settles down.

In taking out the trenches for brick or stonework drains, the sides are left nearly perpendicular, and it is sometimes necessary to support them with planks placed along the sides, and kept apart with transverse short billets of wood. More soil is removed from these than from those for pipe draining, since room must be left for a man to work at the bottom of the trench. The sides of the drain channel are built of stones or bricks as before directed, but the narrow walls for the covering stones to rest upon must not be filled with clay or soil, or mortar. Large crevices should be packed with the smaller stones to keep out burrowing vermin, and a similar precaution should be taken in filling large crevices between the covering stones. Special attention must be paid to the formation of the walls of the channel at all junctions of the branch drains with the main. At such points as these the walls may be built up with mortar between the stones. A similar precaution should be taken in making the joints of branch drain-pipes at their junctions with the main. Fill in the trenches over brick or stonework drains with loose stones, bricks, broken tiles, and similar rubbish, to the depth of a foot or more; on this may be thrown a layer of brushwood before throwing in the clay. In all draining operations in clay, brushwood may be laid in the trenches with some advantage, for it helps to keep the clay above from settling down into the loose layer of stones below. Any surplus clay that may be left out after filling the trenches (and there will be some if much rubbish is used in filling the trenches) should be carted away into heaps, and burnt at a suitable opportunity. Burnt clay, ballast—as it is sometimes called—is preferable to all other material for

filling the bottom of draining trenches over the channels. Such ballast is best burnt in summer time when the clay has been dried in the sun, whilst winter time is generally chosen for drainage operations.

I find that I shall not have room in this article for the necessary instructions on irrigation. They must, therefore, be left over to form part of another article, dealing with the construction of mill ponds, reservoirs, tanks, wells, leats, and other waterworks desirable on a well-planned homestead.

(*To be continued.*)

GLASS-BLOWING FOR AMATEURS.

By ALFRED W. SOWARD.

II.—THE SOURCE OF HEAT—MECHANICAL BLOWPIPES.

IN the previous article it was stated that for the mere bending of small soft glass tube and rod, no blast of air is required, the unaided flame of an ordinary fish-tail or batswing gas burner being sufficient.

For work requiring a small flame of high temperature, such as can be obtained by the aid of a mouth blow-pipe, the Bunsen burner with "blow-pipe jet" is very convenient. This burner is represented in Fig. 5, and its construction is shown in the section, at Fig. 6, where A is an upright tube fixed to a stand, B; C is a small jet from which the coal gas issues; and D and D′ are openings through which air is sucked by the uprising current of gas; a regulator, E, permits of the openings being more or less closed, as may be required. When the regulator is adjusted so that the openings are completely uncovered, a mixture of gas and air burns at the upper end of the tube, A, and a non-luminous, intensely hot flame is obtained, which will be found very useful for rounding the cut ends of glass tubes and rods, and for small work of a similar nature. When the flame is to be urged by a blow-pipe, the regulator is moved so that the air openings are closed, and much convenience will result from the use of the "blow-pipe jet," represented in Fig. 7. This consists of a brass tube of such a size as just to drop into the tube, A, of the Bunsen burner, as shown in Fig. 8. The upper end is flattened into a jet, as appears more clearly in the enlarged sketch at Fig. 9.

In using the blow-pipe with this burner, the nozzle of the former is placed against the angle, F, of the jet, and the small tube carrying the nozzle in a straight line with the flat orifice of the jet, so that on impelling a blast of air through the blow-pipe, a flame is produced, having the position shown in Fig. 8. Such a flame is suitable for making small closed tubes of hard glass for use in chemical operations.

But the amateur glass-blower, who aspires to do work of a more pretentious character than that hitherto referred to, will require a mechanical blowing machine, and a correspondingly powerful source of heat. The common glass-blower's lamp first calls for mention. It is represented in Fig. 10, and consists of a tin body, A, containing tallow, and furnished with hinged lids, B and B′, through which the fuel is introduced. At one end is a projecting wick-holder, C, an enlarged view of which is given in Fig. 11; D is a sliding slip of tin, the movement of which exposes more or less of the wick, and so varies the size of the flame; and E is a tin trough in which the wick lies; F is a cap supported by the movable arm, G, and the latter is kept in any desired position by the wire hoop, H. The cap fits upon the flame, and has two arched openings, one on each side. The blast enters at one, and the blow-pipe flame issues from the other. The blast is applied so that the flame plays over the top of the body of the lamp, whereby the tallow is melted, and a plentiful supply of fuel ensured. The wick should always be trimmed and arranged for the next operation directly after the lamp has been used, as when the fat has become solid the wick is immovable, and then when the lamp is next to be used, time has to be lost while it is warmed before a fire. The wick should form a solid mass about the thickness of a finger, and project ½ inch above the surface of the tallow. To ensure the production of a good flame, sharp scissors must be used in trimming the wick, and the latter should be divided vertically into two halves, which should be slightly separated. The blast is directed upon the opening, and so plays upon the flame itself, and not upon the wick, whereby none of its power is lost.

All who have gas laid on in their workshops will undoubtedly prefer it to tallow, on account of its greater cleanliness, and of the ease with which the size of its flame can be regulated, as compared with the flame of any other fuel.

For work beyond the power of the Bunsen burner, a Herapath gas blow-pipe may advantageously be employed. It is represented in Fig. 12, and in section in Fig. 13. It consists of a double tube, the outer being in connection with the gas supply, and the inner with a blowing apparatus. The gas is first lit, and a blast of air of suitable power is then urged through its midst. By adjustment of the taps, the size and character of the flame is adapted to the work in hand.

A modification of this blow-pipe has been introduced by Mr. Fletcher, of *Warrington*, who is so well known for his ingeniously devised furnaces, and other heating apparatus. It is called the "Automaton Blow-pipe," and is represented in Fig. 14. It is self-adjusting for both gas and air, requiring only a slight motion

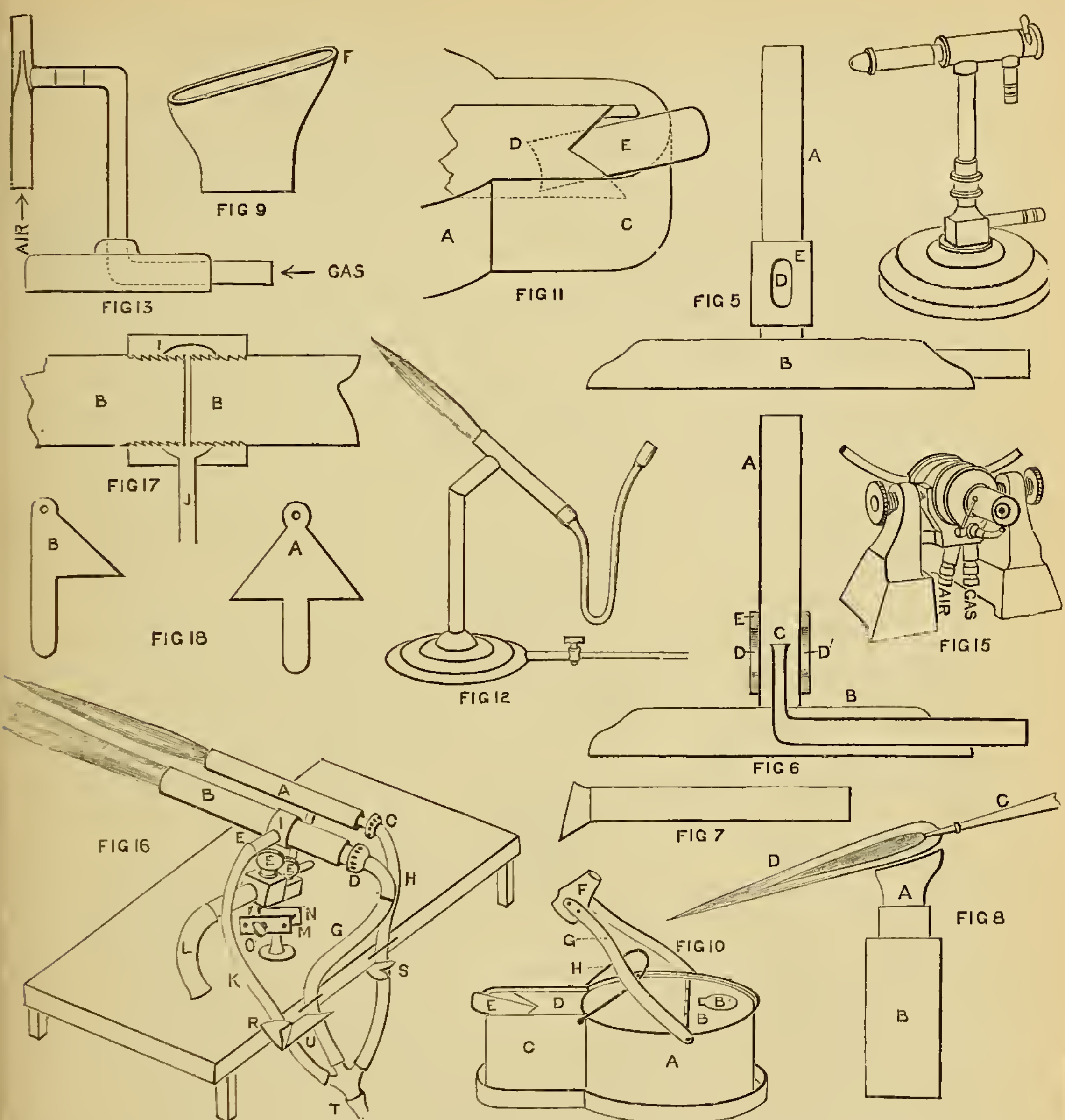


Fig. 5.—Bunsen Burner. Fig. 6.—Section of Bunsen Burner—A, Upright Tube; B, Stand; C, Gas Jet; D, D', Air Openings; E, Air Regulator. Fig. 7.—Blow-pipe Jet. Fig. 8.—Blow-pipe Flame—A, Gas Jet; B, Bunsen Burner; C, Blow-pipe; D, Flame. Fig. 9.—Enlarged View of Upper Portion of Blow-pipe Jet. Fig. 10.—Glass Blower's Lamp—A, Body; B, B', Hinged Coils; C, Wick Holder; D, Sliding Cover; E, Wick Trough; F, Cap; G, Support for Cap; H, Loop. Fig. 11.—Enlarged View of Wick Holder of Glass Blower's Lamp. Fig. 12.—Herapath Blow-pipe. Fig. 13.—Section of Herapath Blow-pipe. Fig. 14.—Fletcher's Automaton Blow-pipe. Fig. 15.—Fletcher's Compound Blow-pipe. Fig. 16.—Groningham's Patent Blow-pipe—A and B, Blow-pipes; C and D, Sliding Tubes for Blast; E and F, Lever Taps; G, H, and K, Indiarubber Air Tubes; I and J, Hollow Clamp connected with Air Supply [See Fig. 17]; L, Indiarubber Gas Tube; M and N, Cheeks of Wooden Clamp; O, Thumbscrew; R, S, and U, Kinking Levers; T, Three-way Air Distributor. Fig. 17.—Enlarged View of a Portion of Groningham's Blow-pipe [See I and J, Fig. 16]. Fig. 18.—Enlarged View of Kinking Lever for Groningham's Blow-pipe.

of the lever, A, to change instantly the size of the flame from very small to very large. Another modification is Mr. Fletcher's compound blow-pipe, which is a double concentric blow-pipe, the gas and air changing automatically from the larger to the smaller blow-pipes by a slight movement of a lever, the same movement also adjusting both gas and air to each other for each blow-pipe, and so giving the fullest and most instantaneous control over the character and size of the flame. This apparatus is shown in Fig. 15.

The last gas blow-pipe to be described is the Patent Combination Blow-pipe of Mr. Charles Groningham, which was specially devised for glass working. This gentleman has been associated with Mr. Crookes in the researches of the latter into the physics of high vacua, and his extensive experience of glass-blowing renders any instrument for this purpose designed by him worthy of attention. The blow-pipe is manufactured by Mr. Casella, of 147, *Holborn*, *London*, and the following description of it is condensed from a paper by Mr. Groningham, published some few years ago in the *Chemical News*:—

A and B, Fig. 16, are brass tubes, $\frac{1}{2}$ inch and $\frac{3}{4}$ inch in diameter respectively, A being used for the production of a small pointed flame, and B for a large flame. Gas is supplied to the tubes separately by the taps, E and F, each of which has a long lever handle projecting to the right of the instrument. These lever taps are very necessary when rapidity is required in turning the gas on or off, as a knock with the finger up or down is sufficient for the purpose. The inner sliding brass tubes, C and D, carry the air jets, the larger being about one-fifth inch in diameter, and the smaller about one twenty-fifth inch. These sliding tubes are necessary in order to adjust the distance of the jets from the ends of the outer tubes, the form of the flame being greatly dependent upon this adjustment. The jets are supplied with air through the indiarubber tubes, G and H. In the interior of the support, I, for the large tube, H, is turned a groove, into which the small brass pipe, J, conducts air through the indiarubber tube, K. The rate at which the air is forced into the tube, B, from the groove, is regulated once for all by screwing B into its support, I, until it nearly meets the other part of the tube, which is screwed in from the opposite side, thus forming a narrow slit, through which the air is admitted equally all round (see Fig. 17). Mixing the air with the gas in this manner causes its complete combustion at the mouth of the tube, the flame issuing being similar to that from a very large Bunsen burner, but much broader. The indiarubber pipe, L, which comes up through a hole in the bench, supplies the gas from the main.

The whole instrument is supported from the bench on a universal joint. The best arrangement consists of two brass balls about three-eighths of an inch in diameter, one attached to the instrument, the other screwed into the bench. These balls are clamped together by two pieces of metal, M and N, through which passes a thumb-screw, O. A joint is thus formed which allows the blow-pipe to be placed in almost any position, and is capable of far more motion than the ordinary ball and socket, and is at the same time very easy of construction.

The air blast is divided by a three-way piece, T, from which indiarubber pipes, K, G, and H, proceed to the different parts of the blow-pipe. These pipes pass the bench in little nicks cut in its edge, and are kept in their places by pieces of metal screwed over them. The passage of the air is stopped by simply kinking the indiarubber tubes, which is quite sufficient for the purpose, and to a great extent prevents the destruction of the tubes by excessive pinching. The kinking is produced by brass levers (cut out of metal about one-sixteenth inch thick) of the shape shown in Fig. 18, A and B

On referring to Fig. 16, it will be seen how these pieces of brass are used. The double one, A, is screwed to the under side of the bench, midway between the indiarubber tubes, K and G. When the projecting arm of this lever is turned to the right, the tube, G, is doubled under the bench, and the supply of air is cut off. On the other hand, when it is turned to the left, the air is stopped in the tube, K, and the supply is restored to the tube, G. In this way the flame can be changed from large to small by simply pushing the lever to and fro. The two single levers, R and S, are of the pattern, B, Fig. 18. R is screwed to the upper side of the bench, and serves to kink K, when the little pointed flame alone is at work, it being then necessary to shut off both the main and side air supplies of the larger blow-pipe. The lever, S, serves to shut off the air from the small blow-pipe.

In the adjustment of the flame the jets should be exactly in the centre of the outer tubes, and about two-fifths of an inch from the open extremity in the case of the large flame, and about three-fifths of an inch in that of the small. The large flame should be equal all round, have a fairly sharp outline, give a steady roar, and should heat in its middle as well as at its edge. The small flame should be moderately long, sharply pointed, and require a powerful supply of air to make it hiss.

The consideration of blowing machines must be deferred until the next article, in which it is my intention to give a description of some of the best that are now in use, and of a home-made machine that any amateur glass-blower may easily construct for himself.

(*To be continued.*)

HOW IT WAS MANAGED.

A SERIES OF PRACTICAL HINTS, SUGGESTIONS, AND WRINKLES.

FROM AMATEURS FOR AMATEURS.

IX.—POLISH FOR WHITE WOODS.

[*From J. F. T. BAILEY.*]

SPENCER'S "INSTANTANEOUS POLISH" has already been favourably recommended to your readers in "Amateurs in Council," and I desire to add my testimony as to its general usefulness. I have obtained very satisfactory results from it, not only on "fret work," but on large articles of furniture. As the pol:sh I first obtained rendered the natural shades of white woods several degrees darker, I wrote to the vendor (Mr. R. Hampson, 205, *St. John's Street Road*, *London*), suggesting the desirability of a *colourless polish* of equal merit for such woods as one might wish to polish, and yet retain the natural hue—as chestnut or holly, for example. Those who use such woods will be pleased to learn that Mr. Hampson adopted my suggestion, and has produced a practically colourless polish. The polish may, therefore, now be obtained suitable for wood of any shade. I have used several bottles of the new "white polish," and am thoroughly satisfied with it. It works up beautifully, with very little trouble indeed; and no amateur need fear failure in using either kinds. The "white" is nominally dearer than the "dark," being 1s. 6d. for the same sized bottle of "dark," at 1s.; but the difference of cost is compensated by the fact that *two* "white" go as far as *three* bottles of "dark" polish; and the "white" is somewhat easier of use. My experience warrants me in unhesitatingly recommending these polishes of "Spencer's."

It is manifest that many of your readers are interested in "polishing," from the recurring crop of questions in nearly every issue of AMATEUR WORK since the appearance of your able treatise on the subject in Vol. III.

As nobody ought to experience any difficulty in using either kinds of "Spencer's Instantaneous Polish," such questions ought to be conspicuous by their absence from future issues of AMATEUR WORK.

X.—CRAMP FOR PICTURE FRAME

[*From ROUGH, Scilly.*]

I SEND you a hint that I think will be of service to some of the readers of AMATEUR WORK who take an interest in picture-frame making. I have found that corner cramps will not do at all times, and the enclosed sketch affords a very serviceable substitute for them. It exhibits the outlines of a contrivance that I find very handy, and it answers to any size, as you can have the line as long as you like and as stout as you like. It is simple in construction, being nothing more than four pieces of elm, A, A, A, A, as shown in Fig. 1, with holes bored through at the corners to reeve the line through, as shown in section at G, in Fig. 3. The line is held and tightened by a piece of hard wood, shown at B, Fig. 1, and on a larger scale in section at B′, in Fig. 2. In this a couple of mortises must be taken out, and two small pulleys put in, and a hole bored above each pulley to reeve the line through. Then at C, in Fig. 2, a nut, E, is let in, with a cleat screwed on to keep it in place, and two brass pins put through D, D, Fig. 2, to make fast the line to. The string is tightened to any extent necessary to bring the mitres close together by the screw, F, which works through the nut, E, and is actuated by the winch handle at the lower end of it.

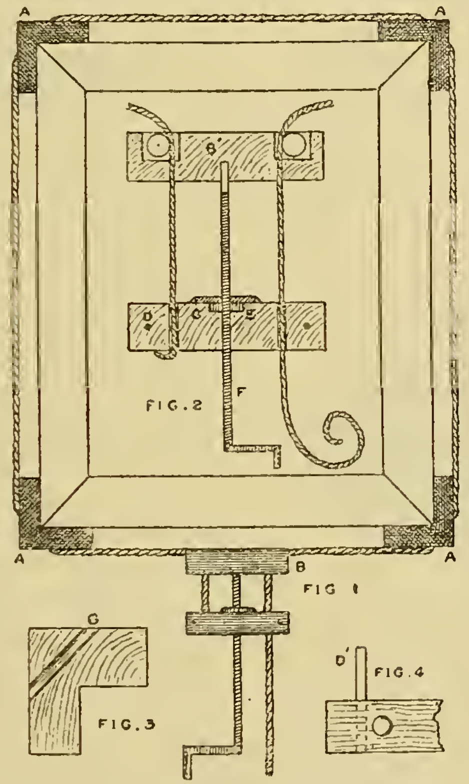


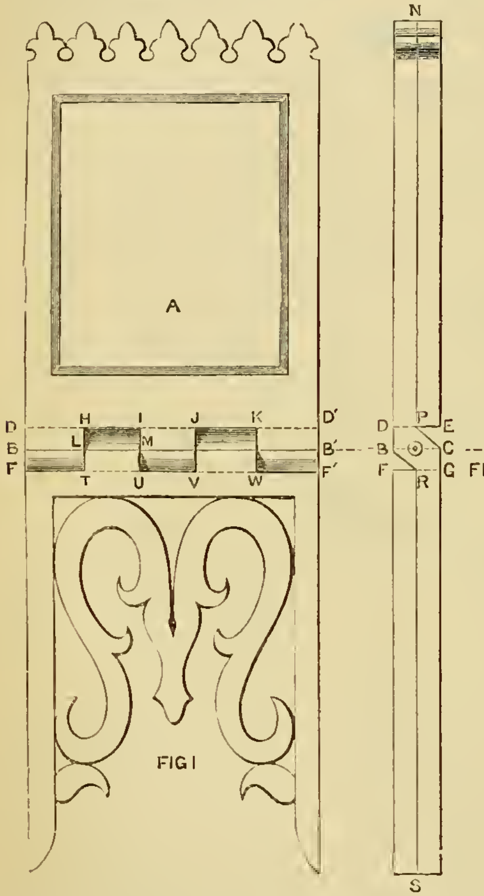
FIG. 1.—DIAGRAM SHOWING CLAMPS PLACED ROUND FRAME, AND GENERAL ARRANGEMENT. FIG. 2.—SECTIONAL VIEW OF WINCH, ETC. FIG. 3.—SECTIONAL VIEW OF CORNER CLAMP. FIG. 4.—ELEVATION OF PEGS IN WINCH.

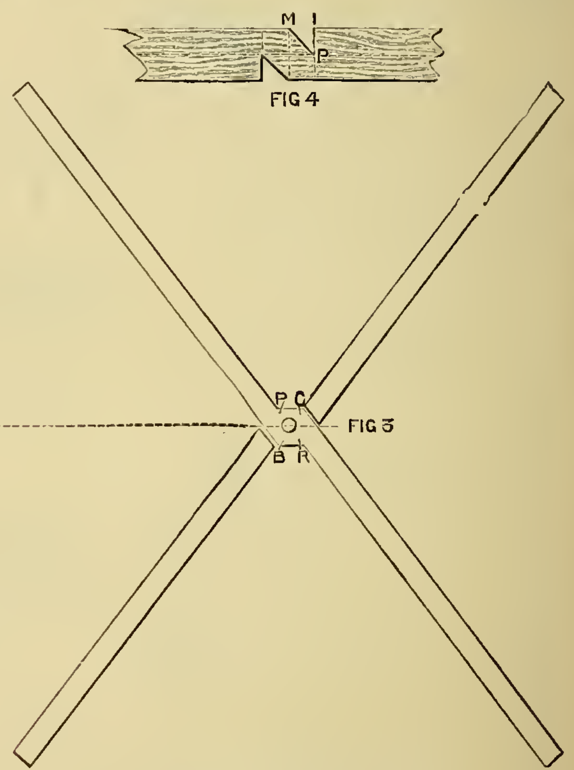
That no difficulty may be found in thoroughly understanding the construction of that part of the appliance in which the brass pins are inserted for the purpose of securing the line, I give a view of one end of the piece of wood in Fig. 4, in which B′ is the pin. The hole through which the line passes is shown to the left of the pin. It is as well to let the line terminate at this end in a loop, which can be passed over the pin D′, before the free end of the line is put through the hole. This obviates the necessity of nailing it to the wood, but it is useful to nail it, because all the pieces can then be kept on the line ready for use at any time. For the sake of economising space Fig. 2 has been placed in the centre of Fig. 1, which otherwise would have been left a blank. It must be remembered, however, that there is no further connection between the two diagrams beyond the simple fact that Fig. 2 is an enlarged sectional view of the bottom part of Fig. 1.

XI.—KORAN STAND IN CAIRO WORK.

[*From C. H. O., Cairo.*]

THE Cairo Koran Stand is a favourite curio, and forms a pretty table ornament, or, if made of a large size, a useful music or album stand. The one shown in sketch is 18 inches high when closed, and looks well on the table; a larger size, to stand on the floor, should be from 33 to 36 inches high. The stand is generally of walnut wood, and is made as follows:—A piece of walnut, 1 inch thick by 18 inches by 6 inches, is planed up, and through O a line is drawn at right angles to the length (see Fig. 2) B O C, and at a distance equal to half the thickness of the wood; on each side of B O C parallel lines are drawn, D E, F G, this is done on both edges. Those joints on edge not shown in Fig. 2 are marked by similar letters dashed. Then in Fig. 1 join D D′, B B′, F F′, and divide D D′ into five equal parts, D H, H I, I J, J K, K D′, and similarly divide F F′.





KORAN STAND IN CAIRO WORK.
FIG. 1.—SIDE VIEW OF STAND FOLDED UP.
FIG. 2.—END VIEW OF STAND, FOLDED. FIG. 3.—END VIEW OF STAND, UNFOLDED. FIG. 4.—ENLARGED SECTION OF NOTCHES. Scale, 3 inches to 1 foot.

Cut out the space at A and the indented top with a fret-saw, also the fret-work at bottom, then slice the wood down from N to P and from S to R, taking care not to go beyond P and R. With a chisel cut down from L M to H I, at an angle of 45°, clearing out the wood down to the half thickness of the wood, when the saw-cut made by preceding operation will be reached (see Fig. 4). Act in a similar way at other shaded parts. Turn the wood over and cut similar holes, taking care that the holes on one side alternate with those on the other side—that is, *e.g.*, on the under side, opposite D H L B, there will be a hole similar to H I M L (see also Fig. 4). With a sharp knife or thin carving chisel cut H T, I U, J V, K W, perpendicularly down to the half thickness of the wood, taking care to make the cuts as fine as possible, or the hinge will be loose, as they generally are in native work, which is always scamped. If this has been carefully done the two halves of the wood will open, as in Fig. 3, on a hinge. The work can be smoothed off between P C and B R with the chisel. The space at A is generally filled up with lattice work, as described at page 561, Vol. II., made of stained beech or lemon, or both combined. Perforated or relief carving might be substituted, when, of course, the Oriental character would be lost. In a large Koran stand a piece of lattice work is inserted between the hinge and the fret-work in lower half, and, of course, the patterns vary with every maker. The lattice work at A is framed with slips mitred at the edges, and the beads are fastened into these slips. The work is not polished.

Many readers of AMATEUR WORK will doubtless find a way to utilise this pretty piece of Oriental furniture for various purposes of a similar kind at home.

NOTES ON NOVELTIES.

By THE EDITOR.

5. Messrs. Churchill and Co.'s New Catalogue.
6. Messrs. E. Wolff and Son's Eclipse Inkstand.

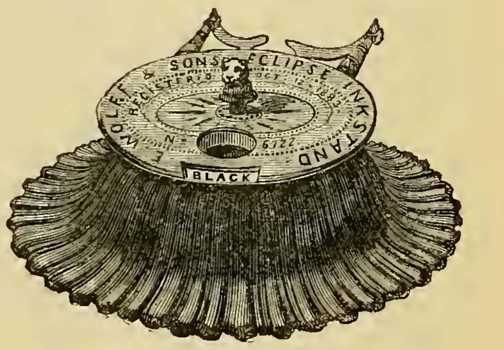
5. MESSRS. CHURCHILL AND CO.'S NEW CATALOGUE.—Accident has delayed the production of the new Catalogue of Messrs. Churchill and Co., 21, *Cross Street, Finsbury, London, E.C.*, for many weeks beyond the date at which it was intended to appear; but any one who desires to have it can now obtain it; its price being, if I am not mistaken, the same as before, namely, 1s. In order to give a fair idea of its character, I cannot do better than quote a portion of the preface: "In issuing our Catalogue for 1885," say Messrs. Churchill and Co., "we do not add so many new pages as we have done in some previous years, still we would ask your careful perusal, which will show some new and valuable tools have replaced others. The continual progress of American inventions necessitates these changes. We would call attention to Universal Grinding Machines, Cutter and Reamer Grinders, Milling Machines, Engine Governors, Reamers, Chucks, Micrometers, Squares, Cabinet-makers' Scroll Saws, Fret Saws, Fret Designs, Planes, Raw Hide Mallets, Horse and Hair Clippers, etc., etc. . . . . Our own list includes the goods from 130 manufacturers, and we need only add that the quality and finish of all goods is being maintained and improved, and the reputation gained during the past twenty years will be fully preserved."

Of course, many of the articles to which Messrs. Churchill and Co. draw attention in the above list are suitable to the requirements of manufacturers on a large scale rather than to those of amateurs; but, as I have often said before, Messrs. Churchill and Co. have specialities other than those mentioned, which present special advantages to, and satisfy special needs of, the amateur. To call attention to these, and to describe them in a proper manner, and illustrate them, is utterly impossible in the space at my command this month, but I hope to do so as opportunity offers, in one or other of the Parts that will compose the current volume. Among articles that I am able to mention now is the Excelsior Lace Cutter, a little tool, sold at 2s., highly valuable. I should think, to colonists, with which leather of any thickness up to $\frac{1}{8}$ inch may be cut into lacing, ranging from $\frac{3}{16}$ inch to $\frac{3}{4}$ inch in width. The cutting blade is easily sharpened, and, when worn out, can be replaced at trifling cost. A handy pocket companion will be found in the New Pocket Oiler, which is made in figured brass, finely nickel plated, at 7d.; and in what is termed new gold metal, at 8d. It is rightly said to be an indispensable article for all bicycle riders, sportsmen, and machinists, and useful in every household. Whatever this "new gold metal" may be, it is soft and brilliant in colour, and does not tarnish. Smokers may obtain from Messrs. Churchill and Co. a neat and light cigarette case in this material, which is the very thing for the breast pocket, and costs, if I remember rightly, 2s. It is known as the "Sultan." As I am speaking of some of the minor articles of Messrs. Churchill's stock whose mention need not be deferred, I may call attention to the steel spoons and forks sold by this firm, which are heavily plated and handsome in appearance, although the form and ornamentation, which is oriental in character, seem somewhat strange at first sight. There are two patterns, the "Prince" and the "Cypress." These heavily-plated *steel* goods have been introduced to meet an existing demand for a suitable substitute for German silver and brass plated spoons and forks, which have poisonous properties and disagreeable odours when the coating of silver is removed by use. The following are the prices of goods in either patterns:—

Tea Spoons ...	6s. per doz.	Dessert Forks...	11s. per doz.
Dessert Spoons	10s. ,,	Table Forks ...	12s. ,,
Table Spoons	12s. ,,	Butter Knives...	11s. ,,

It does not appear that gravy spoons, salt spoons, soup ladles, and sauce ladles are made in these patterns. It is desirable that they should be, for uniformity's sake, and knives also, for eating fish and for dessert.

6. *E. Wolff and Son's Eclipse Inkstand.*—The form and construction of this useful and ingeniously-contrived ink-



MESSRS. E. WOLFF AND SON'S "ECLIPSE" INKSTAND, TO CONTAIN BLACK, RED, AND COPYING INK.

stand, which is equally well suited for the counting-house desk or the library table, is shown in the annexed illustration. It is manufactured by the patentees, Messrs. E. Wolff and Son, Manufacturers of Black-lead Pencils, Artists Materials, and Stationers' Sundries, 55, *Great Queen Street, London, E.C.*, and supplied by them and by all stationers for 2s. 6d. It consists of a ribbed circular metal case $6\frac{1}{2}$ inches in diameter at the bottom decreasing to $3\frac{3}{4}$ inches at top, and $1\frac{3}{4}$ inches in height, to which is attached a plate 4 inches in diameter, into which are dropped three earthenware cups or wells, arranged, with the blank space on the plate, in the position of the four arms of a cross. Over all is another plate, in the centre of which is a metal spill, fashioned in a square pyramidal form below, which drops into a square hole in the centre of the plate that carries the ink wells. The wells are labelled for red, black, and copying ink. There is one hole only in the cover plate, which, from the construction of the spill and the hole that receives it, can be turned so as to admit of the ink in any individual well to be used at pleasure, or to cover all three of the wells when the inkstand is not in use. Thus it is rendered impossible at any time to dip into the wrong ink, and the inks, when not in use, are secured from the entrance of dust and from evaporation.

AMATEURS IN COUNCIL.

1. *Contributors to* Amateur Work *and Correspondents asking or answering Questions in "Amateurs in Council," are requested to write on one side of the paper only.*

2. *When Illustrations or Diagrams are necessary, draw them on a separate piece of paper, because the "copy," as the manuscript is technically called, has to go to the printer, and the illustrations to the engraver.*

3. *Abstain from the epistolary form, as it is utterly unnecessary, unless in letters of business. Put the question you wish to ask, or the reply you wish to make, as briefly as possible, and write every separate question and every separate reply on separate pieces of paper. Sign each with initials, nom-de-plume, or name and address, as preferred.*

4. *Let every paper be headed* Amateur Work, *and follow these words with* "Information Sought," *when it is a query;* "Information Supplied," *when it is an answer to a query; and* "Sale, Purchase, and Exchange," *when it concerns anything to buy, sell, or barter.*

5. *It must be fully understood that no attention will be paid to any letter or communication in which these rules are not rigidly observed.*

[The Editor reserves to himself the right of refusing a reply to any question that may be frivolous or inappropriate, or devoid of general interest. Correspondents are requested to bear in mind that their queries will be answered only in the pages of the Magazine, the information sought being supplied for the benefit of its readers generally as well as for those who have a special interest in obtaining it. In no case can any reply be sent by post.]

Violin Varnish.

Philo-Edinensis writes:—"Will any reader kindly give me his experience in concocting any of the violin oil varnishes given in Mr. Allen's papers in the first Vol. of this magazine? During the summers of the last three years I have made number loss experiments, following carefully and faithfully the directions given, and every one of them were flat and unprofitable. They all turn out yellow, or slightly orange, but in no case did they become ruby red, or if they did they looked thick and cloggy upon the violin. A piece of wood with twenty-five coats of a varnish that looked red enough in the bottle, had a thickness of $\frac{3}{16}$ inch of varnish before it became the colour I desired. But $\frac{1}{16}$ inch is too much to add to a violin's thickness, I think. In every case the best materials were used, and the proper quantities. Anhydrated alcohol, at least 90 o.p., an essence of turpentine, that had stood in some cases for four and six months in a window. I, at least made one hundred and fifty experiments carefully, scattered somewhere over two summers, and accidentally set my workshop ablaze, with no great damage, beyond soot and rust, however—such was my earnestness and enthusiasm. I looked in vain for a reward, but, alas, found none—but epithets, which were not personally dignifying. I, at last in despair, purchased a varnish called Panorma's, which gave me the desirable colour with five coats, but it is thick and cloggy when laid on, and contains a sediment which requires to be stirred up before use. This does not, however, interfere with its transparency to any appreciable extent. As I had gained a little chemical experience last year, I thought I would try to make some varnish this past summer, and at last stumbled upon a much better solvent for the colour than alcohol: this was carbon bisulphide. It is a very dangerous substance to use, as it is very volatile and much more inflammable than even turpentine. This has given a very good result, indeed, although, perhaps, it is wrong to judge of it too hastily, as I only made a quantity of it towards the end of September; but my first experiment made about the end of July has shown no signs of disintegration, and the wood varnished with it stood bleaching for about three weeks, until it was spoilt with rain. I proceeded with its use as follows: The dragon's blood having been pounded fine I put into an eight ounce bottle about half filled with carbon sulphide, shook it well, and the colour began to show when the bottle was set in hot water. The hot water should be below the level of the solution in the bottle. Care is required as the carbon sulphide is very volatile and flies off very quickly. The hot water must not be boiling, as the stuff takes fire at 170° Fahr., I think. With care and precaution, however, no accident need be feared. When sufficient colour has been extracted, and the solution contains just about half its first bulk, it may be filtered through cloth, and the operation should be repeated until a sufficient quantity is obtained. In my case I made a quart bottle of varnish, and used about a pound of the carbon sulphide, which cost me 2s. 6d. The result should be carefully corked after a little cooling, and when quite cold can be used as directed by Mr. Allen with the alcohol; but no heat is required. Merely pour the solution into the ozonized turpentine, and leave the jar or vessel open to the air and stir occasionally with a stick. In a week no carbon sulphide will remain, and the colour is suspended in the turpentine and the gums and other oil added as recommended by Mr. Allen. I found that the carbon sulphide mixes with ordinary commercial turpentine at once, but the resulting varnish would not be siccative enough, I suspect. The great objection which many may have with the carbon sulphide is its smell. It is not *said* to be pleasing, and any left in the varnish flies off when applied to the violin. It has also the great advantage of assisting the drying, and is not detrimental in any way to gums, woods, or colour, as it *entirely* evaporates. I give my experience in the hope that some amateur will give his on this subject. I have laboured through the practical papers on Violin Varnish so often, and the result has been so expensive, and dismally disappointing as regards the colour, that I hope I may be pardoned if I have said anything which is derogatory to the instructions in question. But this is no disparagement to Mr. Allen, as in all the violin-making books I have read, and they are many, I have come across none so full and good as his. I therefore give my experience in this matter with all due deference. I may mention at this time that I tried the experiment of varnishing, as spoken of by Mr. Reade in his Essay on the Violin, and which is quoted in part in Vol. I.; this is putting a highly-coloured spirit varnish above the oil varnish. This I did after the oil varnish had been dry about fifteen months. The surface of the belly of the violin has commenced to crack in rather a peculiar manner, but, strange to say, there is no such appearance on the back, or ribs, or head of the violin. The cracking, however, looks rather well, and has given the violin a somewhat worn and ancient appearance, not altogether objectionable, and which some have even admired; but I am doubtful about repeating the experiment. I have just finished a violoncello; and if anyone cares about it I shall be happy to render him any assistance.

A Momentous Question.

A. F. S. (*Dresden*).—You ask me: "How do you propose that I should obtain a catalogue from Churchill?" Well, when I want the catalogue of any firm, I invariably write and ask for it, and I as invariably get it, but your experience in these matters may be different to mine. I will tell you what I do not propose to do, and that is to send you my copy and pay the postage, or to ask Messrs. Churchill and Co. to send you one.

Making a Patent Article.

A. F. S. (*Dresden*).—I think you may make the patented article without much fear of being found out, for I do not suppose the patentee would recognize it as his own child when it was finished. Still, if you are inclined to tremble at possible consequences do not make it. When Raleigh scribbled with a diamond on a pane of glass in the window of Queen Elizabeth's favourite sitting-room

"Fain would I climb but that I fear to fall,"

the Queen gave him the following excellent piece of advice—

"If thy heart fail thee, do not climb at all."

But I think you might solve most difficulties of this kind without applying to Olla Podrida and myself, seeing, as you put it the other day in one of your many letters, that he and I are a couple of very wooden-headed individuals who are unable to appreciate your queries and services at their right value.

Amateur Photography.

R. R. (*Belfast*).—I have been unfortunate in my writers on Photography. Two have died and two have put their hands to the plough, and turned back. In their room, however, I now have on my staff four that can be depended on, and one of these has offered to write a series of papers on "Dry Plate Photography," which I am inclined to accept for a future volume. Mr. Bewell will give instructions on the preparation of photographic backgrounds. Thank you for your good wishes.

Fittings for Cameras.

A. H. A. (*Durham*).—Messrs. Lancaster and Son, of *Birmingham*, keep and sell all the fittings required for camera making. I believe a letter addressed to them will meet with full attention.—J. P. [To this I may add that the persons named in your letter vouchsafe answers neither to your letters nor mine. When people act in this way it is as well to drop them, and waste no more pen, ink, paper and stamps over them. Messrs. Lancaster and Son will doubtless satisfy your wants. At all events they will not leave any letter from you unanswered. —Ed.]

Electro Motor.

O. T. S.—Thanks for your memo. The promise still holds good, and (n v.) shall be respected. Other work has hitherto taken up all my leisure time. For this reason alone, has the appearance of the promised article been delayed.—G. E.

Electric Regulator for Incubator.

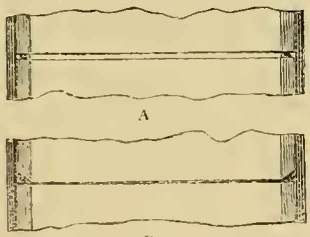
Matthew Stickleback writes :—" May I, through your columns in 'Amateurs in Council,' offer my thanks to Cato for his suggestion of an electric regulator for incubators, given in Vol. III., and may I at the same time make a suggestion for, as I think, a better method of applying it? for it is by this means, picking one another's brains, that I think we amateurs achieve the best results. My idea is taken, I may as well confess at once, from Hearson's Incubator. A year or two ago, when I was keeping fowls, a friend sent me the printed description of these incubators, and the price being beyond me, I cast about to think how I could make one without going to the expense. The difficulty was about the regulator. Hearson's regulator is a capsule filled with a volatile substance that evaporates at the required temperature, and swells the capsule, raising a rod which opens the damper. This substance appears to be his secret and patent, and I could find nothing nearer than ether, which boils at a little too low a temperature. When Cato's article came out I had given up my fowls, and was travelling about, so I have never yet made an incubator on the lines I propose, but I am preparing for the task now, and meanwhile give my idea for what it is worth for my brother amateurs. Hearson's damper acts on the chimney instead of on the ventilating shaft. The incubator has one flue directly over the lamp, through which all the heat passes away clear of the tank so long as the damper is open, but directly the damper is closed the heat passes through another flue, leading out of this first flue at right angles, about half way up. This flue is led through the tank as many times as you like, and is always open at the end. In Cato's plan, as far as I understand it, the lamp is always heating the water in the tank, and the ventilator always counteracting it whenever the heat gets beyond a certain point. In Hearson's directly the damper is raised the heat naturally passes off the nearest and shortest way, and ceases to heat the water, which to me seems the most reliable method of regulation. I make this suggestion with all due respect to Cato, who has had experience in these matters, which I have not, and relying on the maxim that 'union is strength,' and will be thankful for his criticisms, which will help me in making my incubator, if he sees any flaw in the arrangements. I propose using one of the metal fire alarms he suggested, and as soon as I have completed my design and tried it, will send it you to swell your Amateur's Wrinkles if you think it worth it. My suggestion may appear to be an infringement of Mr. Hearson's patent, but I believe I am right (am I not?) in supposing that any one is at liberty to copy a patented design for private use, the patent only giving protection against trading with it. Besides, I believe the patent to be in the capsule, and not the flue arrangement." [I am not a lawyer, and therefore cannot give an authoritative answer on any question of law. To copy a patent for trading purposes is a direct infringement of a patentee's rights, but to make experiments on the plan that he adopts, for private inquiry or private use, seems to me to be admissible. I am open to correction if I am wrong, but if it be not possible to do this—and in doing it no injury is done to the patentee—how would it be possible for any one to make trials for improving on the system involved in the patent, if possible, and thus finding the way to a patent of his own?—Ed.]

Splicing Wire Ropes.

A. W. W. (*Gateshead-on-Tyne*). — Your question on this subject was put in precisely the same form as that which you now use in Vol. IV., page 310, and it was answered by Olla Podrida in page 404 of the same Volume. Please refer.

Conservatory Glazing.

J. B.—In glazing without putty when the panes of glass are placed edge to edge, it is desirable that the edges should meet, and be in perfect contact from end to end of joint. The rain will not then penetrate between the edges. Probably there is an interval of the thickness of the copper tacks used to retain the glass in position between the edges of adjacent panes in your greenhouse (A). To prevent this, the lower corners of the panes should have been cut away to admit of the insertion of the retaining tacks in the wood without preventing the contact of the edges of the panes (B). The diagram



BRADDING IN PANES WITHOUT PUTTY.
A, Wrong Way; B, Right Way.

appended will show what is meant by this. There is no varnish or paint which could be laid over both sheets of glass outside, that would render the roof watertight. Glass should always be bedded on a thin layer of putty, and be cut to fit well between the bars. It should be lapped, and sprigged or nailed over the laps on each side, and finished on the exterior with three coats of good oil colour laid on without any top putty. I fear re-glazing is your only remedy, but if any correspondent can suggest any other it shall be given in these pages for your especial benefit.

"Una" Centre-Board Boat.

D. B. A. writes:—" The address of Messrs. Forrestt and Son, Engineers, Ship, Launch, Torpedo, and Boat Builders, is *Norway Yard, Limehouse, E.*, and *Britannia Yard, West Ferry Road, E.*

J. E. R. writes that Mr. Burgoine, Boat-Builder, of *Hampton Wick, Middlesex*, turns out excellent "Una" Centre-Board Boats, and that he considers them to be the best sailing ones out.

Localities for Fishing, etc.

J. E. R.—(1) To mention suitable localities for fishing from month to month is no part of the mission of Amateur Work. It belongs rather to "Illustrated Sports," published monthly, at 1d., by H. Goy, 21, *Leadenhall Street*, a monthly serial of the greatest use to all amateurs who have a turn for field sports, athletics, etc. Write to Goy on the subject, he is always ready to oblige, and willing to take a hint. (2) You may send me your paper, if you like, *on approval*, but remember what I have already told you, that I have neither time nor inclination to do much "licking into shape" to make articles fit for the printer.

Room without Chimney Breast.

A. W. D. (*Devizes*).—You say that the upstairs room, about which you write, and which is 18 feet by 15 feet, " has no chimney-piece owing to chimney-piece having been built in the adjoining room," and you wish for suggestions for remedying this defect, " so that the grate and mantelpiece may project out into the room, making a recess on each side." From what you say, I assume that the *mantelpiece only* projects beyond the surface of the wall, and that the projection known as the chimney breast (not chimney-piece) is altogether absent, and that you wish to bring the grate forward. As far as I can understand your difficulty without a plan of the structure of the wall between the two rooms before me, it seems that all you have to do is to build two piers, one on each side of the grate, and connect them with a flat arch on which to raise a chimney breast. This will give you a projection and recesses. The grate must then be brought forward between the piers thus made, and the space behind it in its new position filled up with brickwork. The builder to whom you entrust it, will see to making the hearth, which must be altered in position to suit the new circumstances, secure and fire-proof, and he must also take care that the throat of the chimney, or passage from the top of the grate into the chimney which receives the smoke, is properly sloped upwards, so that there are no projecting edges for the smoke to strike against, and be turned backwards. My advice is given without special knowledge of the premises. Your builder will tell you whether or not it can be carried out. Your piers and chimney breast should be as light as possible; the latter, indeed, might be brick-noggin, or even lath and plaster.

Continual Motion in Picture.

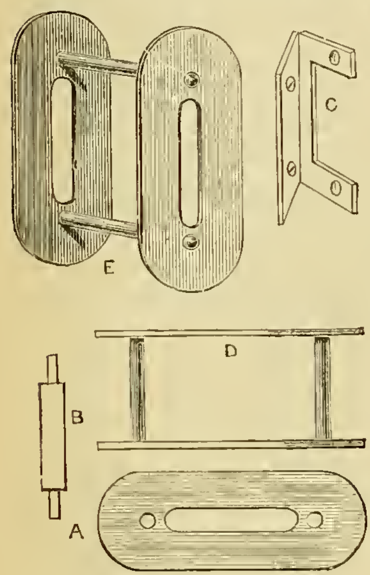
Man Jack sends the following extract from Smith's "School of Arts," for producing continual motion in a picture:— " Place a large picture against a wainscot, in a summer-house, or any other room where the wind may be conveyed to the back of the picture; bore little holes through the wainscot to correspond with some pasteboard wheels that are at the back of the picture; the wind which blows on them through the little holes will put them in motion. Having, on the right side of the picture, subjects painted and fixed to the pasteboard wheels on spindles, they will have an equal motion with them. There may be several things represented in the picture, and their motions made agreeable; as for example, a man grinding knives, a woman at her spinning-wheel, a wind or water-mill, and several other fancies."

Stohrer's Battery.

Battery.—I do not know this. Perhaps some brother amateur may be able to tell you how to charge and work a Stohrer's battery and medical coil. Respecting makers of medical coils, I know of several, but should not like to make an invidious distinction. The most compact medical coil and battery I have seen is that made by Mr. R. Applegarth, Atlas Carbon Works, *Ewer Street, Southwark, S.E.*—G. E.

Coils for Needle Telegraph.

Casenhem writes (referring to remark on this subject in Vol. IV., page 452):—"To make a coil for single needle telegraph, take four pieces of ivory, brass, wood, or cardboard, or, better still, vulcanite, as at A. Old small toothed combs furnish excellent materials. Make a longitudinal slot in the centre of each, drill a couple of holes $\frac{1}{16}$ inch in diameter, one at each end of, and as close as possible to, the slot. Take four



COIL FOR NEEDLE TELEGRAPH.

A, Plan of Side; B, Brass Bar; C, Brass Angle Piece; D, Side Elevation; E, Winder, complete.

pieces of brass, as at B, about an eighth inch thick, and 1 inch long, file down each end to fit the holes, and sufficient for riveting on the angle piece of brass, C. Glue a strip of note paper to form a base for winding on the wire, the size and length of wire depending on what use you put the coils to and battery you intend to use. D shows appearance of side elevation of winder, A serving as the plan, and E is a perspective view of the instrument complete."

"Amateur Work."

W. B. B. (*Dublin*).—(1) You write that you have obtained Vols. I., II., and III., of Amateur Work through your Dublin bookseller, and that you think it might be continued profitably through fully another three volumes also. Let me say that Vol. IV. is now ready, and that Vol. V. is now in course of issue; and, further, that Amateur Work is a Magazine issued from month to month, and is designed, buyers and readers willing, to be continued to the "crack of doom," or at all events, as long as amateurs have hands and will to work. It is in no way a serial publication, to be completed in a certain number of parts, and was never intended to be. (2) The Indexes in their present form are fairly exhaustive. Index-making, like other work, costs money. (3) I am inclined to think that Amateur Work will supply all the information you require on Carpentry, Smithing, and Artistic Work generally, and scientific recreation as well; but I may say that you will find "The Journal of Decorative Art," published monthly at 7d. by Mr. Henry Vickers, 317, *Strand, London, W.C.*, a most useful and interesting source of information on Art Work. (4) As you are now aware that Amateur Work is designed somewhat on the lines of Lord Tennyson's "Brook," you will see that it would be needless to act on your other suggestions, for which I am much obliged.

The Davey Safety Engine.

N. R. writes:—"In 'Amateurs in Council,' Vol. IV., page 590, I see a reference to the Davey Safety Engine, as made by a firm in America. It may be a convenience to your readers to inform them that it is made by Messrs. Hathorn, Davey, and Co., Engineers, *Leeds*. I have a price-list before me by which I see the prices are—

$\frac{1}{2}$-horse power,		£45,	extra for governors,	32s.
1	do.	£54,	do.	38s.
2	do.	£70,	do.	42s.
4	do.	£98,	do.	51s.

They are made up to 10-horse power. They are also specially made for pumping purposes.

A Complaint from A. F. S. (Dresden).

Messrs. Churchill and Co. writes:—"We notice in copy for this month (see Vol. IV., page 590, 'Sweetland Chuck') a complaint from A. F. S. (*Dresden*), saying he has not received any reply from us to his letters. We can only say we find no trace of any letters whatever, or should have sent reply, as we have no objection whatever to afford all the information we can. As A. F. S. (*Dresden*) did not receive reply to his letter, why did he not send us post card to say he was waiting reply? if you will kindly give us the address we shall be glad to write him." [Messrs. Churchill and Co. are now in possession of the address they ask for.—Ed.]

Pressure Gauges.

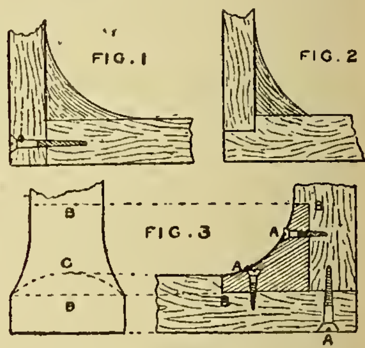
A. F. S. (*Dresden*).—Cannot the physician prescribe for himself? See Vol. IV., page 551.—Olla Podrida.

Revolving Cutter.

C. E. L.—The circular cutter of Dumbleton's apparatus is detachable, and could itself be used much as it is in other instruments, *i.e.*, on a spindle mounted in a forked holder, such as it would be if the short shank of the part were a long one, and all the rest of the apparatus were removed. Geo. Plant would, no doubt, supply cutter wheels of larger or smaller size if desired. I have often thought of such, with rounded edge, for cutting spirals, mounted as suggested.—J. L.

Pattern for Headstock.

A. F. S. (*Dresden*) writes:—"What I wanted to know seems to have been forgotten, viz., how are the patterns put together? Pattern-makers here take the trunk of a tree and cut out the two halves of a headstock from the solid with band saws, shaping and smoothing the headstock afterwards with rasps and gouge. This is all very well for people who have steam or foot band saws, but it won't do for me. I believe that in England it is the custom to build up the patterns, and I want to know how it is done. I have tried two methods but neither are satisfactory. Fig. 1 is liable to twist; Fig. 2 gets broken in the foundry, all the joints are glued; and Fig. 1 is also screwed. The pattern *must* be cast with the arms downwards, or else they are full of holes. Dresden is not Leeds or Manchester, and a sound casting is a rarity. I have tried all the foundries here, save one, and all are alike. The one I have not tried is in a remote part of the town, and has no



PATTERN FOR HEADSTOCK.

Refs. to Letters in Fig. 3—A, A, A, Screws; B, B, Line of Rebate; C, Top of Sole.

reputation. Not long ago I wanted an iron casting 8 inches by 4 inches by $\frac{3}{4}$ inch, and though it was cast three times, every time it was spongy, so I gave it up. And I don't want the headstock to go the same way."

A. J. S. replies as follows to the above:—

In answer to the query put by A. F. S. (*Dresden*) I should not recommend Fig. 1 at all, as the least tap with a hammer would knock the soles in so as to leave the sides projecting, but Fig. 2 is almost like our English way of making patterns; in fact, I think I once answered a query in Amateur Work, and recommended that way of making with another improvement on it, as in the sketch shown in Fig. 3, A. F. S. (*Dresden*) will find that his pattern will not shift much if he makes it in the method described, not even if it gets a knock with a sledge hammer, which is very unlikely. I must, however, say to A. F. S. that if the Germans are no farther advanced in their art than to take a block of wood and saw a headstock pattern, finishing after with a rasp, save me from Germany, I have had *quantum suff. pro hac vice!* Very likely A. F. S.'s pattern in Fig. 2 has broken through not being screwed.

Mending Broken China.

H. M. (*Honfleur*).—Professional menders of broken china are not men who can write, and up to the present time I have not been able to fall in with any amateur who can mend broken plates and dishes with drill and wire clamps. I wish I could. I cannot agree with you in thinking the papers in AMATEUR WORK are "too comprehensive" or "too special." By all means let me have your experience in mending cycles; you write English well, and need have no apprehensions on that score. I will not trouble you for a paper on the mode of boring a hole through a wall for the passage of wire. No correspondent, as far as I remember, has expressed any difficulty on this score. It is on boring, cutting, or sinking holes in solid stone that questions have been asked, and their enquiries on this point have been fairly satisfied.

Omission in Index.

H. G. D. (*Weymouth*) writes:—"I beg to call your attention to an error in the Index, Part 47, if you have not already discovered it, and that is, there is no reference to the papers on Organ Building, except in Amateurs in Council Index. As it is one of the subjects I am interested in, I write to call your attention to it." [I have not already discovered *it*. Please refer *seriatim et verbatim* to the papers on "Organ Building," in Vol. IV., that you say are omitted in the Index.—ED.]

Britannia Company's Combined Lathe and Fret Saw.

F. R. (*Croydon*) writes:—"According to your advice I communicated with the Britannia Company in reference to the Combined Lathe and Fret Saw, mentioned in my previous letter, and they undertook to exchange it for a No. 3 lathe with fret arm attachment, subject to my paying two-thirds price, viz., £2 5s., thus allowing me £3 10s. for my machine, which I agreed to, and I must say I am well pleased with it, for it works first rate, and now I think I shall be able to fully indulge in my favourite pastime. In conclusion, allow me to thank you for your trouble, which has proved of great service to an old subscriber." [I am glad you are satisfied. Your letter bears testimony to the fair dealing and genuineness of the Britannia Company, and their good will to serve and promote the interests of their customers to the best of their ability."—ED.]

Enjalbert Camera, etc.

L. S. D.—(1) The focussing glass, by means of a spring, is kept in its position for focus. When the slide is introduced in *front* of the glass, the glass itself is pressed back to the frame of the box. This is a very old arrangement. (2) Carriers for any sized plate for any dark slide, are simple thin frames of wood fitting inside each other, care being taken that when the plates are placed in them, these plates shall be of the same distance from the lens as is the focussing screen when in position. —O. H. E. J. H.

Miller's Falls, Hand-drills.

F. M. Y. (*Ryde*).—When it is said "the chuck holds drills from $\frac{1}{32}$ to $\frac{1}{4}$ inch diameter," the measurements quoted refer to the sizes of the *cutting points*, and not to the *shanks* of the drills.

Books on Illuminating.

W. G. (*Taranaki, New Zealand*), you will find any of the following volumes useful and reliable:—"(1) Guide to Illuminating and Missal Painting, by W. and G. Audsley, 2s. 6d.; G. Rowney and Son. (2) The Art of Illumination, by H. Shaw, T.S.A., 21s.; Geo. Bell and Sons. (3) Art of Illumination for Beginners, by Delamotte, 9s., small 4to; Crosby Lockwood and Co. (4) Alphabets and Initials for Illuminators, by Delamotte, small 4to, 6s.; Crosby Lockwood and Co. (5) A useful book for amateurs is 'Painting Popularly Explained,' by Gullick and Timbs, price 5s.; from last named firm. It treats on fresco, oil, water colour, mosaic, water glass, tempera, miniature, pottery, glass, and enamel."—H. L. B.

Scene-Painting.

W. G. (*Taranaki, New Zealand*):—"Thanks for your kind appreciation of the articles on Scene-Painting, and glad to hear you get so much valuable information from the pages devoted to the art. In answer to your queries, I may say that it is not necessary to size and prime the canvas on the extreme edge, where it is tacked to the frame, as the tacks would rust and rot the canvas. To obviate this, use only *tinned* tacks. I do not see the object of priming the edge without size, as you mention, and have never heard of it being done either in England or America. In painting drapery, mix up the three tints you require—light, a medium, and a dark—and paint the folds in while the colours are wet, the tints will then blend together, and the work look soft and natural. For amber drapery, use pale and orange chrome, and orange-red, using flake-white for effect; for green drapery, use three shades of green lake; for crimson drapery, damp lake, carnation paste, etc. Drapery painting will be touched on shortly."—H. L. B.

Cheap and Effective Circular Saw Bench.

THE BRITANNIA COMPANY write:—"In reference to your remarks (Vol. IV., page 592) about Circular Saw and the work it can do. To saw wood of 1 inch, is very hard work on many saws—impossible on some—except at absurdly slow speed. But $2\frac{1}{2}$ inch rip-sawing in *long lengths* would pull up a $\frac{1}{2}$-horse steam engine, unless carefully handled. It is *impossible* to invent any saw which will easily do work which demands $\frac{1}{2}$-horse engine to do. Our new patent saw has great momentum, and does work which no other treadle-saw will do. The small saws at £5 are only useful for light work, cutting up large numbers of small thin pieces of wood required in many trades."

Papers on Jewellery.

MAD JACK.—I have the first of the series of papers on Jewellery in hand, but I do not intend to commence the series until I have the whole, or nearly the whole in hand. Perhaps when Mr. Jackson R. Pinwell sees this he will do me the favour to "hurry up."

Rogers' Fret Saw.

HARGER BROS. (*Settle*) write in reply to J. W. H. (*Exeter*):—"It is only fair in weighing the merits of various fret work machines that the cost of them should be considered. For the average fret worker, there is no machine in the market which meets his want so well as the Rogers. The price, 17s., is within the reach of all, and with the improvements lately introduced in the blowers, tenons, and clips, and also a smal pulley guide in the table, it is by far the best value for the money yet introduced. The fault complained of is hardly perceptible when cutting $\frac{1}{4}$ inch wood, and in cutting small articles, if the table is not perfectly level, it would cause the out of square described by J. W. H., especially so when cutting a number of pieces together. We don't know if the Challenge Scroll Saw has been tried. It has the perpendicular stroke, and a powerful tension equal to what most fret saws will stand, but the price, £3 3s., without lathe and drill, makes it prohibitive to many who enjoy the less expensive Rogers."

French Polishing.

W. J. A.—For "full particulars for applying French Polish," please see papers by "A Professional French Polisher," entitled, "French Polishing in all its Branches," Vol. III., pages 79, 206, 262, 363, 406. You cannot have fuller or better instructions than those given in this series of articles.

Practical Lessons in Wood Carving.

H. H. (*Canterbury*).—Before this reply to your letter can reach your eye, you will have found that Mr. E. Arthur Edwards's Hanging Cabinet is not "left in an interesting state of non-completion." That the continuation of the lessons was not announced in the prospectus for Vol. V., was an oversight. It is a difficult matter to think of everything in the first place, when focussing announcements in a prospectus; and, secondly, I cannot exercise compulsion on my contributors, who, for the most part, are men busily employed on other matters of a more serious character, to oblige them to furnish copy with such punctuality that article may follow article in close and unbroken sequence. There are many breaches of this most necessary rule which I could wish were always closely observed.

Box Turning and Inlaying.

C. E. L.—The inlays require no chucking, you should turn a piece between the centres, long enough to make the required number, and then cut off in $\frac{1}{4}$ inch lengths with a parting tool or saw.—LOIDES.

T. F. P. (*Thames Ditton*).—You have a choice of means of attaching chuck to mandrel; you may attach it direct, by boring a hole and tapping it, and screwing the chuck on the mandrel, or if you have a taper screw chuck, you may attach it to that, or you may screw it on to a small face plate with two screws.—LOIDES.

Screw-Cutting Arrangement.

A. F. S. (*Dresden*).—There is nothing novel about the arrangement that you send; indeed, it is rather roundabout in principle. On this account it is not worth while to engrave the drawing.

Printing Press and Type.

W. H. R.—An article on the Construction of an Amateur's Printing Press will shortly appear. It has been announced in prospectus of Vol. V. The cost of sufficient type—old faced small pica—to set up one page of the size of AMATEUR WORK would be at the rate of 1s. 4d. per lb. A page of this Magazine would weigh about 9 lbs.; but you must not imagine that you could produce a page by ordering that quantity, as you would be certain to run upon what we (in the trade) call "sorts," and thereby necessitate a further supply. It might cost you from 20s. to 30s. to provide type to compose a single page.

Le Page's Carriage Glue.

A. H. A. (*Durham*) writes:—"Seeing on page 182, of Vol. III., a glorious description of Le Page's Carriage Glue for woodwork, I sent for some to M. Theodor Eckhardt, and enclosed 2s. 9d., the price for a pint. I received by return a little cardboard box with Richards, Terry and Co., stamped on it, and inside, a little bottle of liquid glue, about a quarter of a pint. This little glass bottle had a label on it with Le Page's name on it, and with only a common cork in it; in fact, it was exactly like a 6d. bottle of gum. It hardly held two pieces of wood together. It says in the description in Vol. III., that the glue was sent out in tins with a patent stopper, mine had nothing of the kind. Can anyone tell me the reason of my receiving about a quarter of a pint of what, in fact, was little better than gum for 2s. 9d.?" [The "Le Page's Carriage Glue," described by me, and used by me, is in a small tin with a screw cover to it. "Le Page's Liquid Glue," which is equally good, is sent out in small bottles, with cork, brush, and tin cover through which the brush is passed. The agents for the sale of these glues are, Messrs. Phillips and Co., late T. Eckhardt, 96, *Milton Street, Chiswell Street, London, E.C.* You had better write to them, and send them the glue you have received.]

A Tradesman's Opinion of "Amateur Work."

F. M. (*Dover*) writes:—"Your paper has, I reckon, saved me about £1 for each number. I mention one case. Through the articles on 'Gilding on Glass' I was enabled to paint my own facia in gold, measuring 25 feet by 2½ feet, at a cost of £6 10s. It took me thirteen days to do, and the lowest estimate I could get for the same thing was £18 10s. I have made the emery wheel grinding machine from your article, and numerous other things. And I feel certain that if every young man occupied his time in carving out some work, according to his fancy, by your papers, he would be improving himself, would be acting and taking the advice of 'Smiles' Self-Help,' and that this would improve the country, stimulate inventors, and be far better than wasting time, as so many do. *Yours is a grand work.* It does not do harm to traders, for in my own case, I could not have had the things I have made myself, and should have made do with a cheap substitute or done without." [The italics are F. M.'s, not mine. I may state that the above remarks are not published through vanity on my part, or for the sake of self-laudation, but in order to show the positive utility of AMATEUR WORK to professional men as well as to amateurs, and that the object I had in view in establishing the Magazine—namely, to render assistance worth having to those who are willing to help themselves—has been attained.—ED.]

ORGAN BUILDING.

Failure of Sound in Stopt Pipes.

A. W. (*Croydon*).—It seems to me that your failure to get your wood stopt pipes to sound when the stopper is in, must either be caused by your block being too far forward, or else your stoppers do not fit, or the joints of the pipes are not sound. Try filing the windway of one of your pipes a little further back, and if it makes it too large, the inside face of the cap could be rubbed down a little, so that the size of the windway would then not be increased. Proceed cautiously, taking but a very little off the surfaces before testing, and if the defect is a little remedied, you will soon see what is required. The other defects mentioned above point to their own remedy. If the pipes are properly constructed, there ought to be no possibility of failure.—M. W.

Construction of Small Organ.

IAGO CYBI.—It is quite possible to construct the small organ you desire in a height of 5 feet or so, by either planting off all the larger pipes, or by placing them on a separate soundboard on the floor, either at the back or at the sides of the instrument, and having stickers with a thrust action to push open the valves. Read carefully the article on Pedal Action and Arrangement, and you will see how this can be managed. The bellows and action would be placed below the keyboard. For the stops, I would suggest Stopt Diapason, CC to G, 56 notes; Open Diapason, Tenor C to G, 42 notes; Flute, CC to G, 56; and another 8 foot stop, such as a Dulciana, Gamba, or Keraulophon, or the treble part of the Stopt Diapason might be omitted, and a Vox Angelica substituted. If it is required to be movable as you suggest, The case must be constructed with a base board, or some other support for the lower soundboard, and the pipes must be fixed in their places, which is not a very desirable arrangement.—M. W.

Stains in Books.

W. W. (*Horley*)—If the book is not bound in cloth state the kind of binding and colour, and I will endeavour to help you. If the book "stained" with water be bound in cloth, the "dark place" can be very fairly restored to its original colour by thinly glazing it with the white of an egg or clear parchment size. Apply with camel-hair pencil, or tip of forefinger. Clean water does not "*stain*," but it removes the calender glaze from the cloth, and gives it the appearance of being blotted. The egg or size partly restores the glaze. An article on repairing damaged books will probably appear in Vol. V.—J. B.

Boiler for Small Engine.

OLLA PODRIDA comments on reply given by A. F. S. (*Dresden*), to J. H. (*Whitchurch*) Vol. IV., page 593:—"Another very simple thing in connection with steam engines is that—all other data remaining the same—the horse-power varies as the square of the diameter of the cylinder. Another little trifle affecting the horse-power is the speed at which the engine is run. I presume these are but trifles in your estimation, seeing that they are ignored in your strictures on J. H. (*Whitchurch*). But it is only another clear case of the 'beam' and the 'mote.'"

INFORMATION SUPPLIED.

Atmospheric Motor.

W. E. writes in reply to F. R. G. (*Framlingham*):—"I suppose you mean hot air motors, heated by gas or paraffin oil, or ordinary fuel. These have been tested, and I saw two at work at the Britannia Company's factory at *Colchester, Essex.* One was fitted with a small and very compact pump, it worked noiselessly, and is well adapted for organ blowing. I am assured they cannot explode, and it seems anyone can manage them."

Steel Tube for Poppit Cylinder.

N. R. writes in reply to A. F. S. (*Dresden*) Vol. IV., page 593:—"I think Messrs. Cotton and Johnson, *Gerrard Street, Soho, London, W.C.*, are as likely people as any I know of to have steel tube, such as required. I fear you would find it near to impossible to bore a 14 inch long steel cylinder without a boring collar."

OLLA PODRIDA writes in reply to A. F. S. (*Dresden*):—"Do you put the query on the above out of mere curiosity, or do you really want a cylinder? We will, for charity's sake, suppose the latter to be the case. Well, then, if I were in your place, I wouldn't worry the United Kingdom about it, nor risk setting the steel manufacturers at loggerheads with one another in their efforts to meet your very special demands. And, again, always supposing myself in your place, with the same ideas, then, as a matter of course, my wants would be very urgent indeed, and of the utmost importance. Well, supposing that to be the case, and also that I regained a few of own ideas, I would then buy 14 inches of steel, and drill it myself, and would try to arrange that the hole should be of some convenient size. As to the absence of a boring collar in your premises, I am all broke up to think that so extensive an establishment is minus such an every-day convenience. My advice is, that you dispose of your 'travelling crane,' which you use for casing your boilers, and assume a boring collar."

Quick Drying Black Varnish.

D. B. A. writes to inform A. B. that a quick-drying black varnish may be made by mixing a sufficient quantity of lamp black with brown hard varnish. Strain the mixture through muslin. A. B. must not expect this to give as good results as French polishing.

Black Polish without Staining.

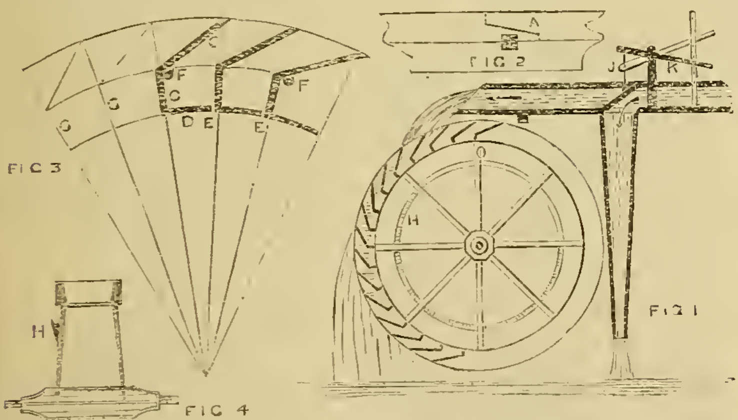
D. B. A. writes that the preceding is also a reply to W. H. P.'s enquiry about Black Polish without Staining.

Waxing Meerschaum Pipes.

Walking Chimney writes in reply to I. F. G. (*Limehouse*):—"That meerschaum pipes may be re-waxed and the colour brought up, by rubbing the pipe, while hot, *i.e.*, while it is being smoked, with a piece of beeswax or wax candle. If waxed unevenly, and the line of colour is not straight, dip the bowl to the required depth in chloroform. Re-waxing requires patience."

Water-Wheel.

J. B. S. (*Kennington*) writes:—"In reply to Transvaal, I give a rough sketch of water-wheel, as used in Cornwall for mining purposes, and mill work in general. He says an overshoot breast or undershoot would do. For a wheel to be twelve-horse power, it would have to be 16 ft. in diameter, which would require a fall at least 18 feet high—that is to say, an overshoot wheel, which is twice the power. He could get over the difficulty by carrying the water in wheel out of rims, 24 inches; depth of rims, 14 inches, and $1\frac{1}{4}$ inch thick; arms or spokes, to be 3 inches by $2\frac{1}{2}$ inches at axle-tree, $2\frac{1}{2}$ inches square at rims, lapped or halved to inside of rims—rims to be halved together at A (Fig. 2), on spoke B; if plank is not wide enough, also halve between spokes. At C, C (Fig. 3), groove for buckets inside of rims, $\frac{1}{2}$ inch deep, number of buckets, double to diameter: thus our wheel is 16 feet and 32 buckets; if 10 feet, 20 buckets, and so on. The belly, D, is nailed to outer edge of rims; E, E, slits or holes through belly for air to escape, otherwise the buckets would not half fill; F, bolts, $\frac{3}{8}$ in. diameter, through both rims near corner of front lip of bucket with nuts outside to keep the wheel together; O, G, method of getting proper pitch for buckets; H, H (Fig. 4), tooth wheel or groove rim for rope or chain: if more power is wanted fix closer to buckets; I (Fig. 1), waste shoot when not working; J, trap door in bottom of shoot, piece of leather for



CONSTRUCTION OF WATER-WHEEL.

Fig. 1.—Water-Wheel in position, with water on and off. Fig. 2.—Mode of Halving Rims on Spoke. Fig. 3.—Mode of Setting Buckets in Rim of Wheel. Fig. 4.—Vertical Section of Wheel through Axle.

shoots, fixed on a level with pair-leg trestles until he has obtained the required fall. If he is on an incline he can fix his place for the wheel, and go down at a point low enough and dig a trough up to the wheel, which probably will give him half he requires. The wheel should be fixed on stout wooden trestles or a strong stone wall built in the soil, with a large stone on the top to take the bearings. If he cannot get fall enough, he must reduce the height, say 8 feet, and 4 feet breast. Such wheels are very slow, but powerful under a good stream of water. The axle-tree, usually oak in England, should be made of pitchpine, all other parts, of best Norway, or red deal, which will stand just as well. Square up axle-tree to 12 inches, and chamfer to eight sides, square off outside of mortise, 30 inches, 15 inches from centre, 3 inches long, $1\frac{1}{2}$ inch wide. Cut through each side, leave the mortise something shorter in centre of axle, as you will dish it in at felloe like a bicycle wheel, height, 16 feet, 8 feet radius, speed will be about 3 feet per second with the quantity of water at command. Greatest width of hinge along seam; K, lever for closing and opening, be sure to get enough clearance under the wheel, or otherwise it will be water-logged—shoot to carry water in second bucket from the perpendicular line, O. Should there be any other questions you wish to ask, I shall only be too glad to answer them to the best of my ability."

J. J. S.—Your query as to the construction of a water-wheel seems to be fully answered by the above. If, however, there be any point that is not covered by it, write again and point out your difficulty.

Shooting Block for Picture-Frame Making.

C. H. S. (*Wandsworth*) replies to Perfect, and hopes that the accompanying illustrations will clearly show him the way out of his trouble. To make the block, let the wood be oak or beech. In Fig. 1, A and B are the right and left side boards, $1\frac{1}{2}$ inch thick, and of any height and length to suit; C, the bottom block, about three inches thick, any width to suit; D, D, shows open space caused by block, C; E, cross stay. If the block be a large one the wood stay will be necessary, but not for a small one. Fig. 2 shows the relative positions of block and

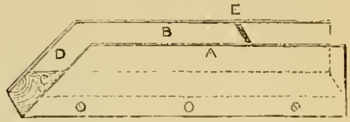


FIG. I. — RIGHT-HANDED PLANING-UP BLOCK FOR MITRE.

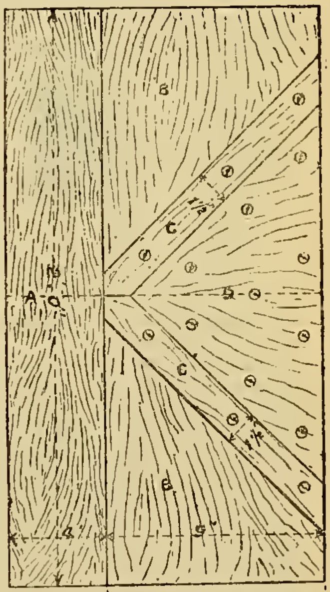
plane when in use. This block could also be used for the ordinary mitre-cutting box

FIG. 2.—SIDE VIEW, SHOWING POSITION OF PLANE WHEN IN USE.

by simply sawing the cross through middle of box.

No. 149 writes:—"In reply to Perfect's request in Vol. IV., page 503, for information for making a shooting block for picture-frame making, I hope that the accompanying sketches will be of use to him. The

FIG. 1.—PLAN.



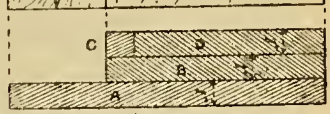


FIG. 2.—SECTION.

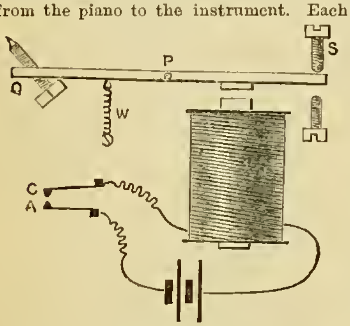
SHOOTING BLOCK FOR PICTURE-FRAME MAKING.

A, Bottom Board; B, Board on A; C, Lodges screwed on B; D, Wood between Ledges to back up. The Section is shown along centre dotted line A D.

material used in its construction should be yellow pine. If he makes it correctly, he will find it a good and serviceable article. The construction is so clearly shown in the diagrams that further explanation is unnecessary.

Electrical Music Printing.

Casenhem writes to J. T. (*Exeter*) in reference to this subject, Vol. IV., pages 152, 357:—"I am sorry pressure of business has prevented my replying to this sooner. I now give a rough outline, should our musical friend (page 357) require more particulars, I shall gladly help him. Arrange under each key, a small thin spring c, to press on a stud A, so that when the key is depressed, the electric circuit is established. A wire is run from each spring and stud to a battery and electro-magnet, as in figure. The armature is pivoted at P, and is held against the top screw or stop S, by the spiral spring, W. When a key is depressed, the corresponding electro-magnet draws down its armature, and throws, or pushes, the stylus Q against a band of paper, (ruled or sectional), thus giving an indented impression to the paper. This indent represents one note. The paper, which should be divided into as many lines, corresponding to the number of styles and notes required to be printed, is drawn tightly over the styles by means of clock-work. The apparatus may be placed at any distance from the piano, and wires led from the piano to the instrument. Each



BATTERY

APPLIANCE FOR ELECTRICAL MUSIC PRINTING.

stylus indents the paper as long as its corresponding key is held down. The paper should run at an even speed. I should think ½ inch per second would be quick enough to receive the impressions of an ordinary player; but a preliminary experiment would soon settle this point. This system necessitates the use, or making a lot of magnets, which, however, could be made cheaply by winding the wire on the legs of a soft iron (horse-shoe shaped) bar direct. One battery of two or three elements would suffice to work all the magnets, providing the latter are suitably wound. I have thought out another way of doing the printing-in ink with one or two magnets only, but it would require to be well made, so if you do not like the first method I will describe it."

Glass Turning.

A. F. S. (*Dresden*) writes in reply to J. M.—"At the workshop of the Polytechnic here (namely, *Dresden*), much glass work is done for electrical purposes, etc., I therefore asked for their method of working. The answer I received was—'That to *turn* glass is unsatisfactory. A diamond is required, but the result is the splitting off of small flakes, and the surface turned is quite rough. The only way is by grinding with copper bits and emery. Boring is done by copper tubes and emery. The emery is mixed with oil.' The foregoing is well nigh a literal translation of the reply given to my inquiry."

INFORMATION SOUGHT.

Heliograph.

W. S. M. writes:—"Help from Casenhem to construct an Amateurish Heliograph will be thankfully received. Required to signal across the valley, some three miles, from a window." [Casenhem is requested to forward the information desired by W. S. M. at the earliest possible opportunity.—Ed.]

Rusty Boiler.

Breezy Blackpool asks:—Can any one tell me what to do to get the rust off my kitchen boiler, which is an ordinary lid one. I have lime-washed it once, and the water was very clear for a week or two, but soon went as bad as ever?

J. B. (*Stonham*) wishes to know what to do with a new iron fountain, which was put into a cooking stove about five months ago, and in which the water is always of a dirty red colour. It has been cleaned out frequently since it was put in, but that does not seem to improve it.

Flat-Bottomed Canoe.

Would-be Canoeist writes:—"Mervyn Kennedy in his excellent articles on 'Boat Building,' says of a canoe made on a similar plan to the boat described in Vol. I., p. 325, that it would in many respects be a superior article. Would he or some other of your correspondents, kindly give me the pros and cons of a canoe so made, as I meditate making such an one? Would it be suitable for use on the sea? Would it be any advantage to have the sides slope slightly by making the bottom a little smaller than deck plan? Any hints would greatly oblige.

Relief Stamping in Colours.

J. (*Newbury*) writes:—"I wish to stamp my notepaper from my own steel die, and should be glad to know how colour-stamping is done, and where the materials could be got?"

Washed Para Rubber.

Man Jack asks:—Will Beniamin, in his reply on "Mending Mackintosh," tell me where to procure the washed Para rubber he mentions?

French Polishing, etc.

G. H. H. (*Canterbury*) puts the following queries:—

(1) I have repeatedly tried to polish (French) an old writing desk, first I scraped and sand-papered off all the old polish, and then oiled and polished according to directions given in Amateur Work, and when I spirited it off it went dull and streaky. Can anyone tell me the cause?

(2) Can anyone tell me what polish it is used by men on the Girdler Light Ship, who make deal boxes, veneer them with walnut wood, and afterwards finish off with polish or glaze of some kind?

(3) What is it that is used in staining brackets, etc., which you buy cheap at shops? They are a deep black, which has a sort of polish with it.

(4) I saw some writing desks, etc., at the Lowther Arcade, with a splendid polish. Can anyone help me in this; also, where I can buy the polish, etc.?

(5) Will the Editor at some time give us working drawings of a work box and writing desk, with all the internal fittings, with a secret drawer, if possible? [I cannot undertake to make any promise on this point, for I have so much matter on hand, whose early appearance is imperative.—Ed.]

Winnowing Machine.

Rough (*Scilly*) writes:—"Will you ask if any of 'ours' can give me some hints for making a winnowing machine for winnowing corn, say, wheat and barley?" [To clear away the chaff of wheat, the grain must be placed in a tray with a wire bottom, to which a horizontal motion to and fro is imparted, and above is a circular fan, whose rotary action causes sufficient motion in the air to carry off the chaff. The small grains pass through the sieve, and are used for fowl-feeding, etc., the larger grains remain in the sieve, and are sent to the mill. This, briefly stated, is the principle of the winnowing machine. I leave it to others to write a paper on the construction of one for home use. You will not want a winnowing machine for barley. This is stamped or beaten with an appliance consisting of bars in a frame, placed transversely at the end of a handle, like a broom handle, but larger and stronger. The downward action of this gridiron-like tool clears the grain of the remains of the awn.—Ed.]

Coating for Canvas.

K. A. T. asks:—How is the black composition made and applied with which the canvas of dress baskets is covered?

Violoncello Making.

J. R. (*Barrow*) wishes to know if he can be supplied with dimensions and information respecting Violoncello making. [My advice to you is to borrow a violoncello, and take the dimensions and pattern from the borrowed instrument, and then proceed according to Mr. Allen's instructions in his Papers on "Violin Making," remembering however that the work is done on a larger scale. Perhaps amateur violin makers will tell you what wood to use, and if any special appliances are required for the manufacture of the violoncello.—Ed.]

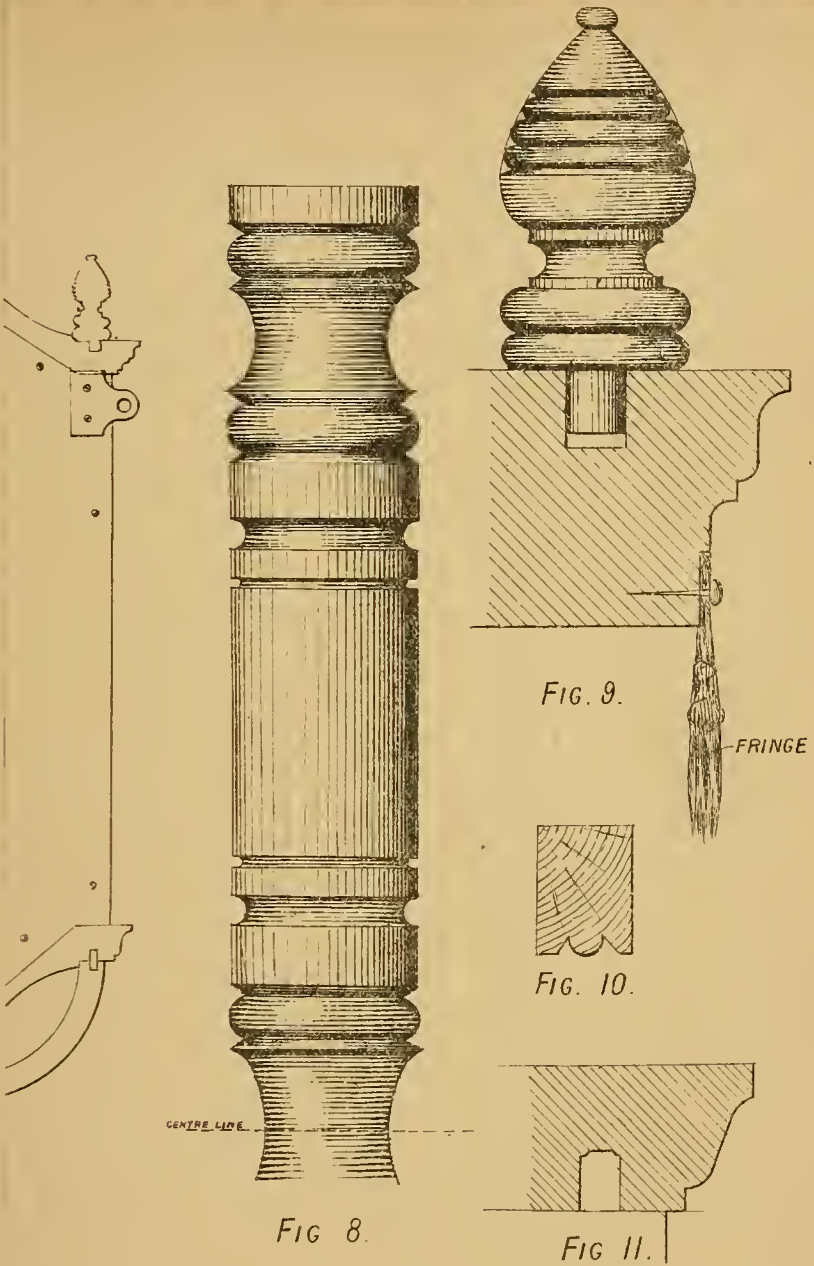
Japanning.

D. E. wishes to know how japanning is done, such as is found on shear handles and sewing machines? I know they have to go through a process of baking. What temperature would they require, and how long and how are the transfers put on?

COMMUNICATIONS AWAITING REPLY

W. G. B. (*Limerick*); F. R. (*Croydon*); Waito.—Replies to the preceding kept waiting by non-receipt of cnts to accompany them.

Olla Podrina; J. B. (*Mendlesham*); Magnet; K. A. T.; Joiner; W. D. (*Liverpool*); Ajax; W. S. M.; E. W. C. (*Bradford*); Britannia Company; Man Jack; Hare's Foot; Naturalist; An Old Subscriber; W. H. R.; E. W.; F. M. (*Dover*).



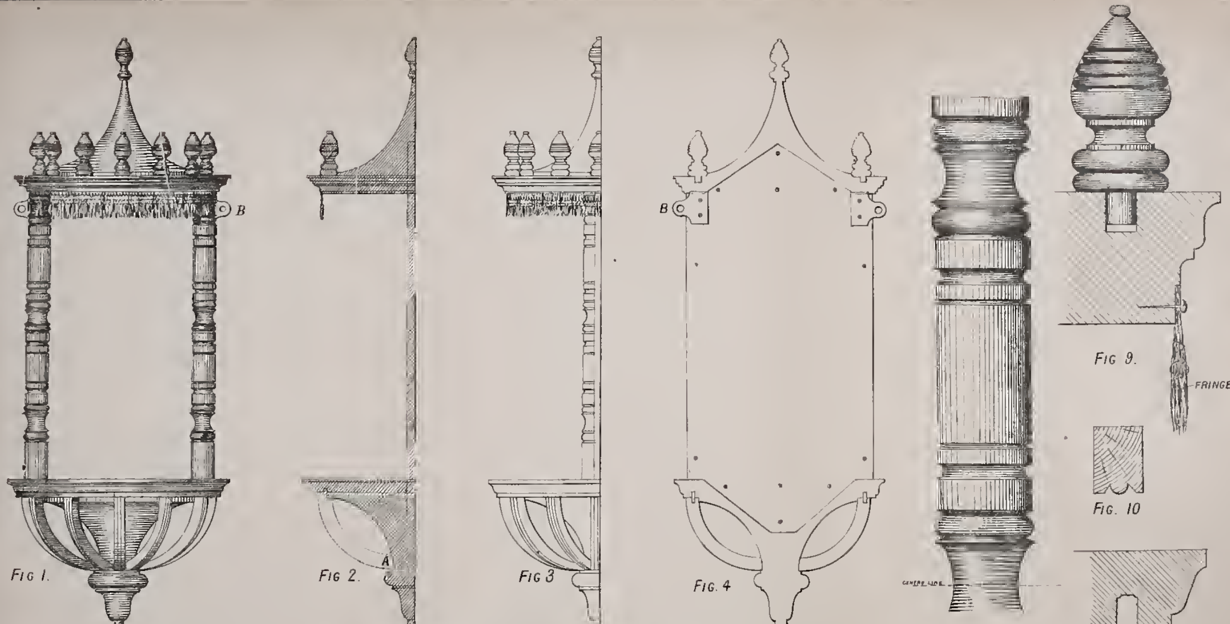
ORNAMENTAL SHELF.

for Turners.

Specially Designed for Amateur Work.

BY ALEXANDER MARTIN.

WITHERBY & Co LITHO 325 HIGH HOLBORN LONDON.



SCALE FOR FIGS 1.7

INCHES 12 9 6 3 0 1 FOOT

ORNAMENTAL SHELF.

for Turners.

Specially Designed for Amateur Work.
BY ALEXANDER MARTIN.

WARD, LOCK AND CO., WARWICK HOUSE, SALISBURY SQUARE, LONDON, E.C.

MODEL YACHTS:

HOW TO DESIGN AND BUILD THEM.

By ARTHUR C. HIDE.

III.—THE HULL (*Continued*)—PAINTING—LEAD KEEL—FINISHING HULL—MEANS OF PROPULSION—CENTRE OF LATERAL RESISTANCE—AREA OF SAILS.

I PROMISED to show you how to find the right weight of lead that is required for the keel, but you will have to rig your model, according to instructions which will come hereafter, before you can find it out properly; and I shall, therefore, have to imagine that the rigging part of the business is finished, and that you know the exact weight of your boat with all her gear, etc., except, of course, the lead keel. I should have liked, had space permitted me, to show you how to do this by figures or theoretically, but as it would take up too much room, it will have to be done practically—that is to say, by experiment.

Firstly, then, take your rigging down and the deck off (which, by the way, is not screwed quite down yet, but only held in place by a screw here and there) and give the hull a coat of ground paint inside and out, and when that is dry give it a second. Now mark your water line carefully on the model (taking the distances from the sheer plan) with a strong black pencil, and then screw your deck on as before, and put the rigging in place again.

You must then take her to some piece of water, or if you have a bath in the house that will receive her, all the better, and having supplied yourself with some weights, say a 4 lb., a 2 lb., two 1 lb., and some smaller weights, put her afloat, and steadying her by the masts place as many weights along the centre of the deck as will bring her fairly down to the water line. Mark around the places lightly where these weights are, and take her out of the water again. You have, of course, taken note of the different amounts in the various places before taking her out of the water, so we will suppose that you had three weights on her, of 4 lb., 1 lb. and ½ lb., making altogether 5½ lbs. Now measure the distance that the centre of the 4 lb. weight was from the stern, and do the same for the other two.

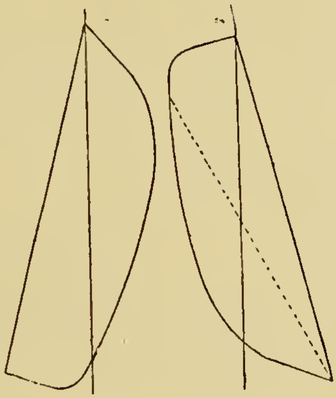


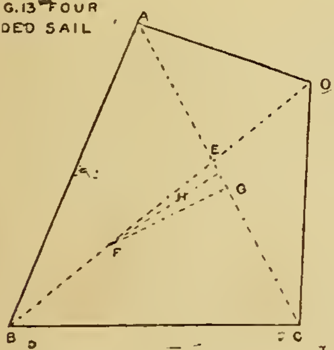
FIG. 10 DETERMINATION OF CENTRE OF GRAVITY

Let us imagine these distances to have been, 4 lbs. at 10 inches from the end of the counter, the 1 lb. at a distance of 22 inches from the same place, and the ½ lb. at a distance of 24 inches. Multiply each of these weights by their respective distances, and add the products together, then divide by the total mass of the weights, and the quotient will be the distance that the centre of gravity of your lead keel has to be from the end of counter.

Thus in this case, $\frac{40 + 22 + 12}{5\frac{1}{2}} = 13\frac{5}{11}$ which you may call $13\frac{1}{2}$ inches.

DETERMINATION OF CENTRES OF GRAVITY OF SAILS

FIG. 13 FOUR SIDED SAIL



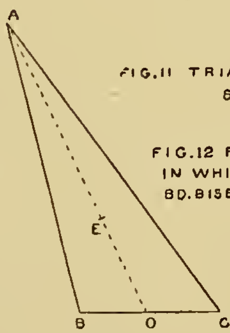
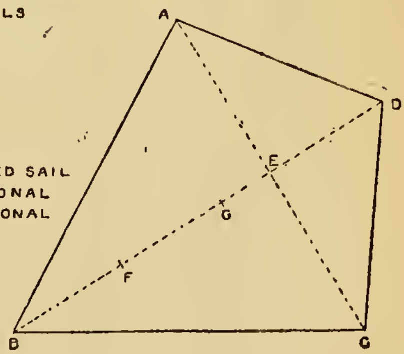


FIG. 11 TRIANGULAR SAIL

FIG. 12 FOUR SIDED SAIL IN WHICH DIAGONAL BD. BISECTS DIAGONAL AC.



Mind, this is the distance from the end of counter and not from the end of L. W. L., therefore, I should advise you to mark it at once on your drawing. Before you have your lead cast you should see that the centre of gravity of the pattern comes on the right place (that is, the place you have just found), for if it does not, you must alter the shape of the curve till it comes right, taking care not to increase the weight.

You can now set to work and finish the hull. Get some finely ground pumice powder, or get some pumice-stone and pound it to a fine powder yourself, and with a rubber of cloth and this powder rub the

hull down, using a little water at the same time, until all the brush marks are out of the paint. A circular motion will be best for this, but it requires a fair amount of patience since the model must be like a piece of glass when done.

This is only the ground paint that you have smoothed, so you must consider what colour to paint your boat. A black top looks nicest to my idea, and a flesh colour for the bottom shows the black off very well; but you can do about that as you please. Lay two coats of the bottom colour on her, rubbing *each* coat down as before, and then if you intend painting the top side black run a pencil line along where the two colours are to meet. They should join above the water line all round the boat, but the line should be somewhat higher at the bow than at either the stern or midship section. To get this line on nicely, paste strips of paper along it, on the under side, and then you can paint away without fear of the paint getting below the line and spoiling the regularity of it.

For the black part you should not use ordinary paint, but get some of that stuff which is used for "ebonizing." It is obtainable at almost any large colourman's, and a small bottle will go a long way. This is preferable to paint, because it does not require rubbing down, and as the deck should be put on before the top is painted, there is no fear of spoiling the appearance of it.

The deck should be put on with putty for the joint, and screwed down at regular distances. If you do not like the appearance of the screw heads on the deck, they can be covered by a narrow beading of mahogany, fastened all the way round the edge with fine brads, and having here and there slots cut in to allow the water to run off the deck.

A coat of the best copal varnish over the whole will, I think, finish the hull. This varnish, though, should also be rubbed smooth, if it is found to be in the least lumpy when dry; and let me try and impress on you the necessity of rubbing down these coats of paint and varnish in a proper manner, because the rougher the outside of a ship is, or say rather a model, the more resistance she offers in going through the water, and, consequently, the slower she will go. But if this roughness is reduced to a minimum, as by patient scrubbing it can be done, the particles of water have nothing to lay hold of, and, therefore, the resistance is so much less, resulting in a greater speed with the same amount of driving power.

Talking of driving power reminds me that I have not yet mentioned anything about the "means of propulsion."

When a boat is sailing, the forces of the wind acting on her sails can be brought to a resultant acting at a certain point in the plane of the sails termed the "centre of effort," and the position of this point, in relation to another point, termed the "centre of lateral resistance," plays a very important function in the sailing qualities of your model.

The "centre of lateral resistance" is a point below the L. W. L., in a plane passing vertically from stem to stern through the centre of the vessel, through which the resultant of all the forces of the water acting on the sides of the vessel when being pushed sideways through the water, acts. In fact, to make this a little clearer, if you could fasten a string to the centre of lateral resistance, and pull the boat through the water sideways by it, she would come broadside on exactly, and would neither swerve to the right nor the left. You can therefore easily see that, since the wind striking a vessel tends to drive it sideways through the water (called leeway), the centre of effort and the centre of lateral resistance should be in the same vertical line, for if the former were in front (further towards the bow) the vessel would, when sailing, tend to turn away from the wind, and thus lose headway; whereas, if the centre of effort were behind the centre of lateral resistance, she would "come up into the wind," in both cases altering her course, which should be prevented as much as possible in model yachts, because you are not, unfortunately, on board to handle her yourself, and must therefore do all that when she is on shore.

I will now, before I go into the different styles of rig, show you how to find these two rather important centres. Let us begin with the easiest, viz., the centre of lateral resistance. The best way for you to find this is to cut out in thin wood or cardboard, the shape of your sheer plan under water, and find the centre of gravity of that by suspending it first from one corner and then from the other, the place where the strings cross being the centre of gravity, Fig. 10. Now mark this on the corresponding position in your sheer plan, and that will be the centre of lateral resistance. For the centre of effort you must first find the centre of gravity of each sail, as I will show you further on, and square all these centres down on to one horizontal line, and then multiply the area of each sail (which I will show you how to find presently) by the distance that the centre of gravity of that sail is (on the straight line) from the centre of gravity of the head sail. Add these different products together, and then divide by the sum of the areas of the sails, and the quotient will be the distance that the centre of effort of all the sails is from the centre of gravity of the head sail.

Thus, suppose you have three sails, and having found the centres of gravity and squared them down on to a horizontal line (say the L. W. L), work out the areas. We will imagine the area of No. 1 sail (head

sail) to be 50 inches, and the area of No. 2, 120 inches, and of No. 3, 100 inches, and the distance of centre of gravity of No. 2 from centre of gravity of No. 1 to be 10 inches, and from No. 3 to No. 1 to be 20 inches.

Then $\frac{(120 \times 10)+(100 \times 20)}{50+120+100}=11\frac{23}{27}$, or not quite 12 inches; 12 inches is the distance of the "centre of effort" from the centre of gravity of No. 1 sail. This rule applies to any number of sails, topsails included.

Now we will see how the centres of gravity of differently shaped sails are to be found. Let us take an ordinary triangular sail to begin with, as A B C, Fig. 11. Bisect any one side, say B C in D, and join the corner A, opposite the bisected side with the point of bisection D. Then divide D A into three equal parts; and the first point E, *i.e.*, one-third of A D from D will be the centre of gravity of the triangle, or rather in your case of the sail.

For a four-sided sail, Fig. 13, you join B D and A C, and from B mark off B F equal E D, and from C mark off C G equal A E. Join F G and the centre of gravity of the triangle E F G (found as shown above) will be the centre of gravity of the whole sail. Should it happen that one of the diagonals, say D B, bisects the other A C, then mark off from B the distance B F equal to E D, and one-third of E F from E will be the centre of gravity, G, required, Fig. 12.

The next thing is to find the areas of your various sails, which is as simple as finding the centres of gravity.

Firstly, then, for a triangular sail. From any corner drop a perpendicular on to the opposite side, or, if necessary, the opposite side produced, and multiply the half-length of that perpendicular by the side on to which it has been dropped; so if your perpendicular measures 20 inches, and your base 7 inches, the area of the sail will be $\frac{20}{2} \times 7 = 70$ inches. If the sail happens to have one angle a right angle, it will, of course, only be necessary to multiply the half length of one side adjoining the right angle by the whole length of the other side adjoining the right angle.

For four-sided sails simply draw a diagonal, dividing the sail into two triangles, and then find the area of each triangle separately, and the sum of these two areas will be the area of the whole sail.

In drawing out the sail plan you will have to guess first of all the shape and size of the various sails, and then when drawn out you will have to calculate the centre of effort, and see if it comes on the centre of lateral resistance, and if it does not, the sail plan must be altered till it does, by taking some off the fore sails, and adding to the other sails, or *vice versa*, as the case may be.

The total area of the sails should be about fifty times the area of the midship section below the load water line. If your vessel happens to be pretty deep, you can even increase it up to fifty-five or even more times; but if she is a pretty shallow boat keep it rather less. The area of the midship section you must find approximately by making it into a triangle.

This refers merely to the "fine weather suit" of sails, but you should have three sets of sails for your model, or at all events two, each set being about a fifth less than the preceding one, so that your smallest set, "the storm suit," will be three-fifths of the "fine weather suit." I don't believe in "reefing" model sails, because you can never get the sail to set properly when reefed, and it takes just as long to reef a sail as it does to take it off and bend a fresh one.

You will, of course, see at once why you want three sets (or let us say more than one set, because I know some people that are too lazy to make three sets, and think two almost more than enough). A model wants as much sail as possible in light winds, and, of course, when it comes over squally, some canvas must be taken in, and as taking off either head or top sails would alter the position of the centre of effort, you must have exactly the same rig as for fine weather, only a little smaller, and when it comes to blow a gale she must have a smaller suit still.

I think I can commence now with the next chapter, and show you how, first of all, to choose your rig, and what rigs are most adapted for models, and then how to get your rigging put up; but, of course, you must draw the sail plan out first, and calculate all the necessary centres, etc., before you can begin rigging her.

(*To be continued.*)

GLASS PAINTING AND DECORATIVE GLAZING.

By L. L. STOKES.

I.—BEAUTY OF STAINED GLASS AS A MEANS OF DECORATION—TOOLS AND APPLIANCES—MATERIALS.

IN those minds which have a natural turn for art, few things are more calculated to excite a desire of imitation than is fine stained glass; the beauty and brilliancy of its colour delights the eye, whilst the almost imperishable qualities of the material mark it out as one on which taste and labour may worthily be spent.

Yet among those who would gladly attempt this beautiful art, the greater number shrink from it, as too difficult for them. Now, that there are difficulties in the way of the amateur glass painter is not to be denied; it may, however, safely be asserted, that in

this, as in most other arts, there are none which will not give way before ordinary perseverance. In the absence of a personal teacher, the best help to success will be a course of sound, plain, and practical directions; and this, it is hoped, the present papers will be found to supply.

Indeed, in decorative glass work, a satisfactory amount of success may be said to be within the reach of whoever cares to devote the necessary time and attention to it, for in this art good work may be produced of various kinds and degrees. Whilst figure subjects may be made to give scope for the highest talent in design, and the greatest technical skill in working out, there are other and less ambitious methods of rendering glass ornamental, for some of which, as for plain pattern glazing, only the most ordinary mechanical skill and patience are demanded. There are three principal modes in which glass windows may be, and in past ages have been, legitimately rendered decorative—firstly, by the use of stained glass; secondly, by enamel painting on glass; and, thirdly, by plain pattern glazing. In practice, these methods are often used, more or less, in combination, as will be seen as we proceed; but for clearness of description, we shall at present do well to regard them as distinct and separate departments of the art.

Of these, the first and most important method is by the use of stained glass. In this, the effect mainly depends on the original colour of the pieces of glass employed. A stained glass window is a mosaic, in which the component pieces were stained of various colours when they were made, and these are so arranged, and united by leads, as to form pictures, or geometrical or other designs. From stained glass only is to be obtained that richness of colour and brilliancy of effect, which are among the most attractive characteristics of a decorative window. To complete and harmonize the design, however, more or less painting has generally to be spent upon this glass. It is by work of this class that throughout the Middle Ages, and since the Gothic Revival in the present century, church windows have commonly been enriched.

Enamel painting on glass is far less effective in its results. In this second method, sheets of plain white glass are employed, and the design is painted upon them in enamel colours, which are then so fused as to be converted into a part of the glass. A species of transparent picture is thus produced. But the film of colour thus formed on the surface is, and always must be, feeble when compared with colour infused through the mass of the glass in making.

Painted glass, as compared with stained work, is always weak and dull, yet there are purposes for which it is to be preferred; in the window of a dwelling-room, for instance, where the glass is constantly near to the eye, and where the coarse lead lines, which connect stained work, and the iron bars necessary for its support, would be unsightly. Or, again, in the large squares which so often fill the sashes of modern houses, where stained work would be out of character, enamel painting may come in as an appropriate and valuable means of decoration.

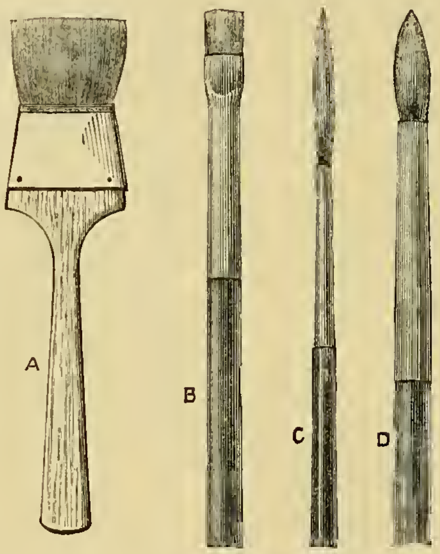


FIG. 1.—BRUSHES FOR GLASS PAINTING.

It was by this second process that the church builders of last century adorned their windows with transparent reproductions of the pictures of great masters. The success which they achieved was not, however, such as to warrant a continuance of the practice.

The third and last legitimate mode of window decoration, plain pattern glazing, is properly effected with plain or white glass; the ornamental result being attained by the arrangement of the lead lines which unite it. In the domestic architecture of the Elizabethan age, this branch of art was carried to a high degree of excellence. In our own times it has been much revived, especially in connection with what are called "Queen Ann" buildings. In modern plain pattern glazing, glass of two or more tints is often used, instead of white only, as formerly. Window ornamentation by this means is an exceedingly easy matter. It demands no artistic skill or costly materials, nor is there the difficulty of firing, which is so often a serious bar in the way of stained and painted glass work. It is, in fact, within the reach of any amateur who can learn to use such simple tools as the diamond and the soldering bit.

Tools and Appliances.—Before proceeding to processes, it will be well to have some knowledge of the tools and materials to be employed, and of their cost. For the purely mechanical work of cutting out the glass, and of fixing it together, it will be necessary to

have a glazier's diamond (which will cost about 15s.), a pair of pliers, and a stopping knife (which will cost 1s. each), and a copper bit for soldering (cost 2s.).

For colour grinding, a ground glass slab, a glass muller, and a palette knife, should be provided, which, together, may be set down at 6s. To serve as palettes for the colours, nothing will be found better than a few six inch squares of ground glass (which will cost 3d. each).

For actual work upon the glass, will be needed, a flat badger-hair brush, about four inches wide, to be used for "matting"—a term which will be explained by and by; or, instead of it, what the writer uses in his own practice, a flat camel-hair varnishing brush, such as that shown at A, Fig. 1, which will be found less costly. Two or three short and stiff hog-hair tools, such as that at B in the same figure. These should be of various widths. Their use is to act as scrubs for removing the "mat" where necessary to show lights. Long and fine sable or camel-hair pencils for tracing and lining; those of sable are best; C, Fig. 1, shows the most useful size, but larger ones will be useful for bolder work. Larger camel-hair brushes, such as D, for putting in washes of tar-spirit colour over the "mat," and for other uses. These must be soft, that they may not disturb the "mat" or other work beneath. Various sizes will be useful; some with round, some with flat points. Ten or twelve shillings will buy a sufficient number of brushes, and they may be had at any artists' colour shop, as may also the grinding slab, muller, knife, and palettes. The glazing and soldering tools may be bought at any tool shop.

For holding the glass during the operation of painting, it is usual to have a transparent easel. Such a contrivance is shown in Fig. 2. It consists, as will be seen, of a wooden frame-work filled with a sheet of plain glass, behind which is stretched a sheet of semi-transparent paper. Upon this sheet of glass the pieces to be painted are placed; and as the easel is, when in use, set between the operator and a window, sufficient light is transmitted through it to enable him to see the proper effect of his labour. In order that the light may not be intercepted, it should not, like the ordinary easel, have a back leg in the centre, but instead of it, two legs, as shown, at the sides. The shade overhanging it, which is of mill-board, and the arrangement for raising or depressing which is sufficiently explained by the illustration, is useful to prevent unnecessary light from coming to the eyes of the workman. From this example, any carpenter could make the frame-work for about five shillings.

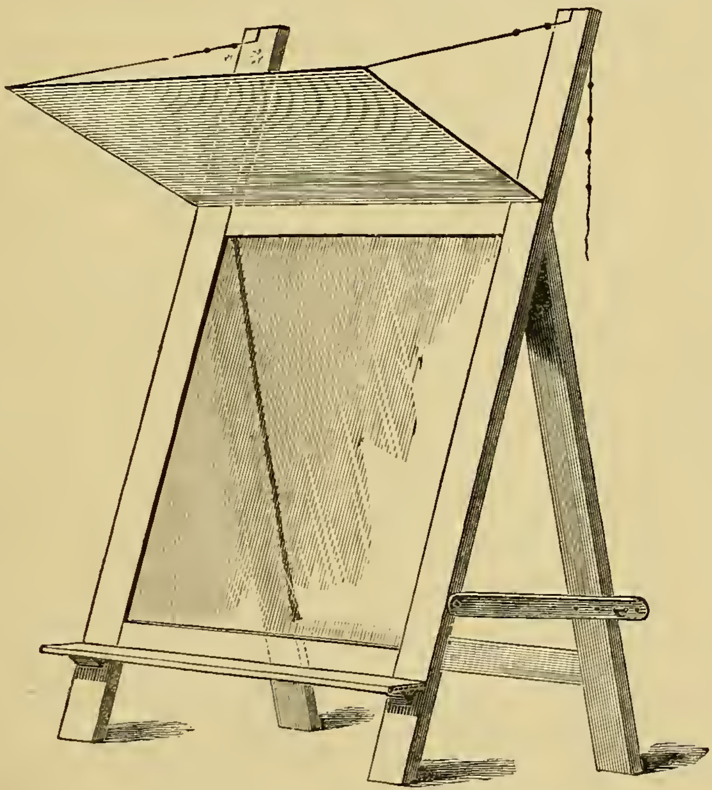


FIG. 2.—TRANSPARENT EASEL.

Such are the more necessary and important appliances, and as will be seen, they do not involve any very great outlay. Some other matters will probably be found of use, but these will be more properly mentioned as we proceed with our work.

Materials.—Among these, the most important is, of course, the glass itself. Coloured glass is of two kinds, one known as "pot metal," the other as "flash glass." In the first, the colouring matter is diffused through the whole thickness of the glass, and in this we find the richest and most beautiful hues. In the second, the body of the glass is white, but over one side of it is spread a film, or flash of colour. Though as a rule, inferior in effect, there are, as will be seen hereafter, purposes for which flash glass has great advantages over pot metal. Coloured glass may be had at various prices. The most rich and costly pot metal, which is "ruby," cannot be set down at less

than 2s. per square foot. Other colours may run to about 1s. 6d. per foot. Cathedral glass, which has a dull greenish tint, and a somewhat waved surface, and which is much used in house decoration at the present day, both in plain pattern glazing and as a ground on which to paint medallions, etc., will also cost 1s. 3d. to 1s. 6d. per foot. The plain glass to be used as white in stained work, is somewhat rough on the surface, and is known as "silver white;" this has a much better effect than any smooth clear glass. The general ground in enamel painting should be ordinary sheet glass, of, say, about one-tenth of an inch in thickness, and when cut, showing a green tinge in its edges. It will cost about 6d. per foot. Plate glass, which is more costly, does not take colour well, and is not suited for painting upon. At the more important glass warehouses, all the above kinds of glass may be bought.

The lead used for fitting stained glass work together is essentially the same as that seen in old-fashioned casement windows, but, narrower; it is made in the same way—namely, by forcing pieces of cold lead between rollers, from which they issue in long strips of the required form, that is to say, much like the letter H in section. The rollers can be set to make it thicker or thinner, at the pleasure of the workman; and the artist can, if he pleases, make the lead lines in his design stronger or more delicate. The cost of this material varies somewhat with the market price of lead; we may set it down at about 3½d. per pound, "string" lead being somewhat dearer that the other "sizes," owing to its taking more labour to make the pound of it. The solder used for fixing the leads should be a fine one, that is one which contains a large proportion of tin. Such a solder might cost about 2s. per pound.

Some other trifling and inexpensive materials will be needed in leading up, such as resin, whiting, linseed oil, and lampblack, which will cost but a few pence at the oilman's.

Apart from the matting and tracing colour to be presently described, *two* applied colours only are used in stained glass work. These are china pink, with which the faces, hands, feet, etc., in figure subjects are tinted on a ground of plain glass; and gold stain, which is a brilliant yellow wash, often found most useful for picking out the letters in inscriptions, the ornaments in borders, and for other purposes. His gold stain, the operator may make for himself, by dissolving silver to the extent of a half-crown piece in a gill of nitric acid, and precipitating it with the addition of a handful of common salt. His china pink he will buy from a professed glass painter, or at a shop where glass painting materials are sold. All such things are to be had from Messrs. Brodie and Middleton, *Long Acre, London*, who are the retail agents for the materials prepared by Mr. Hancock, of *Worcester*. It may be mentioned that Hancock prepares a "flesh red," which some prefer to china pink, neither is perfect, the first inclines to orange the second to purple.

At a similar place, the matting, or tracing colour, will have to be bought. By the use of this, whatever lines or shadows are introduced into the work, will have to be produced. In tracing colour, the colouring matter is either an oxide of iron or of copper, ground with a powdered glass, and some earthy substance, such as ochre, to give it a body. At Brodie and Middleton's it is to be had in various shades of brown or black, in a powdered form; tracing brown, raw umber, and tracing black, are oxides of iron, ancient brown and jet black are oxides of copper. The operator will choose his shades according to the nature of his work.

The colours for enamel painting are made of certain proper mineral pigments, fused with a kind of soft glass, and afterwards ground to a fine powder. These also will have to be bought as above, and for a sovereign, the beginner in enamel painting on glass may buy a stock which will last him for some time.

(*To be continued.*)

THE REFLECTING TELESCOPE:

ITS CONSTRUCTION AND MANUFACTURE.

By EDWARD A. FRANCIS.

III.—THE SPECULUM GRINDER'S WORKSHOP (A).

VERY few of the arts have been practised under such varying circumstances as that of speculum grinding. Its votaries have included workers of all grades in life—those able to furnish and maintain a well appointed workshop, and those scarcely able to purchase the material wherewith to work. So that the reader need not be downcast if fortune has denied him a spacious sanctum. For the actual grinding and polishing there is requisite no more room than will suffice to accommodate a barrel of ordinary dimensions, and permit the worker to walk comfortably round it. For the testing, a room or passage of a length exceeding the radius of any proposed speculum by three or four feet will be necessary. An ordinary passage or pair of communicating rooms may be pressed into service, and the late night being the time most suitable for the prosecution of the mysteries of testing, tremor in the house being then at its minimum, no objection is likely to be raised to the operator

securing the lowest passage in the building for his purpose. The presence of a fire in the workroom is a matter of taste, but an equable temperature should be maintained while the processes of polishing and figuring are being performed.

The sketch that is given in Fig. 19 shows the writer's workshop with a workman in position at the bench. From a study of tbis the reader will discern that no special or elaborate contrivances are required by the speculum worker. To support the tool while working a firm isolated bench, of convenient height, is needed. It should be of dimensions such that will enable one to work comfortably witbout stooping, and at the same time to have a full command over the whole surface. A tall square bench, having its supports firmly fixed and strengthened by wide cross rungs so as to require considerable force to move it, was used for some time by the writer, but a barrel has been substituted for this with considerable advantage, and a barrel or cask firmly fixed to the floor, and weighted if necessary, forms an excellent bencb. That shown in the sketch is immovable, being nearly filled with hard earth well rammed down. Variations of the supporting bench (such as a revolving post actuated by the feet, thus dispensing witb tbe necessity of walking round), have come under my notice; but they are not to be recommended, one becomes thoroughly accustomed to tbe habit of continually moving round after a very sbort time.

With the old handworkers the bench or post was marked round its edge into six or eight equal divisions, and the support cemented to the back of the speculum being similarly numbered, the operator was enabled to maintain a certain regularity in the revolutions of the speculum over the tool. This is a refinement, however, which can be dispensed with.

The tool or polisher may be fastened to the bench in several different ways, considerable latitude as to tbe method adopted being allowed: but it is essentially necessary that the fastening should be rigid and the tool evenly supported. Possibly, the reader may have in his possession some combination of screw or socket that may be adapted for this purpose. Lest he should not, in Figs. 20 and 21 are shown two distinct methods, each perfect for the purpose. The illustrations are almost self-explanatory. In Fig. 20, the disc of glass for the tool is cemented to a metal face-plate with pitch. The face-plate is then screwed upon the bolt F, until it reaches the nut C, when additional rigidity is given by tightening the butterfly nut E. This contrivance is somewhat elaborate, but that shown in Fig. 21 cannot be surpassed for simplicity and completeness, and as the excellence of the speculum does not depend upon the complication of the tools used in its construction, so that they only answer their purpose; the second method may be adopted with perfect safety by those of my readers who study economy. A slight disadvantage attaches itself to its use, owing to the fact that four screws have to be removed to separate the tool and the bench. In Fig. 21, A is the disc of glass for the tcol. To this is cemented in the usual manner a wooden disc of about equal diameter and thickness, to raise it from the bench. To the wooden disc B is screwed a square wooden baseboard C, which in its turn is attached by screws to the bench. It may be mentioned that the top of the bench and the tool should be carefully levelled before working, and the head of the barrel should be strengthened and firmly attached to its staves. By another method the tool is cemented to a heavy iron block, which evidently would be retained firmly upon the bench by its own weight.

If the process requiring metal tools is followed, it is obvious that the bench screw first shown should be used; but I shall, for the future, assume in these papers — since the working in both processes is identical—that the reader is working by Professor Thomson's method.

The specula of reflecting telescopes were originally constructed of speculum metal. This metal was an alloy capable of receiving a very high polish, and its ingredients were often varied for special purposes, the chief portion being generally, however, copper and tin. A typical composition for a seven inch speculum is :—144 ozs. of finest copper; 68 ozs. of grain tin; 4½ ozs. of white oxide of arsenic. The copper and tin combined gave a reflective metal of extreme brilliancy, but brittle and porous. To remove the former defect, brass was added, arsenic removing the latter. Silver was occasionally used to add to the whiteness of the completed alloy. For melting together these metals a special furnace was generally constructed, and great difficulty was experienced in successfully casting a speculum, owing in part to the different degrees of heat at which copper and tin melt. When the casting was at length complete, it required to be carefully annealed. Notwithstanding this, a more delicate and brittle metal could scarcely be obtained. A careless blow, or the expansion of a few drops of water which might freeze under it, being sufficient to break a large speculum. With these facts before one, there is small wonder at the statement, that except in isolated cases the use of metal for specula has entirely died out.

About thirty years ago, M. Liebeg discovered a chemical method by which an exquisitely fine film of pure silver could be deposited on the polished surface of glass. This film adheres firmly to the glass, and microscopically assumes the figure of the surface to which it is attached, being, according to the late Dr.

H. Draper, not more than a two hundred thousandth part of an inch in thickness. The process was immediately adapted to the production of silver on glass specula. The weight of glass is from one-third to one-half that of speculum metal. As I write there are beside me two specula, each $5\frac{1}{2}$ inches in diameter: the one of glass 1 inch thick, the other of speculum metal but $\frac{7}{8}$ths of an inch in thickness; yet the latter exceeds the former in weight, and this is a disadvantage when the time for mounting the completed speculum arrives. But independent of the question of weight, a silvered speculum of glass is far preferable to a metallic reflector, in that the figure imparted to the glass surface is, with ordinary treatment, permanent; the silver being renewed when the original coating has tarnished, without any necessity for repolishing the glass. A metal speculum, on the contrary, once tarnished, requires the application of the pitch polisher to restore it, and, consequently, it has to be re-figured. Lastly, the reflective power of pure silver is much greater than that of polished speculum metal, so that a good silvered glass Newtonian Telescope in perfect condition, will reflect to the focus at the eye-piece, nearly five sixths of the light incident on the principal speculum, almost double the quantity which speculum alloy would reflect under similar circumstances.

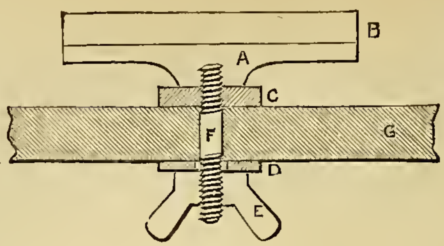


FIG. 20.—GLASS DISC CEMENTED ON METAL FACE WITH PITCH.

A, Metal Support (Face Plate); B, Glass Disc for Tool; C, Nut on Bolt F; D, Washer; E, Wing Nut on Bolt F; F, Bolt passing through Bench; G, Bench.

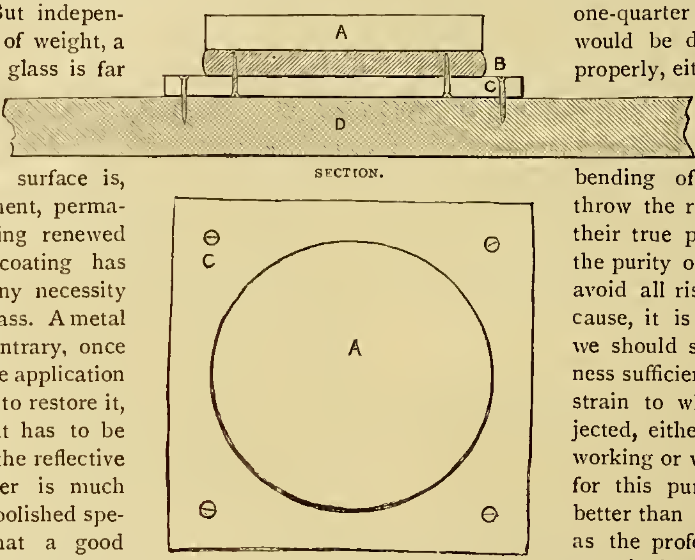


FIG. 21.—ANOTHER MODE OF FASTENING DISC TO PLATE.

A, Glass for Tool cemented with Pitch to B; B, Disc of Wood to raise Glass from Bench; C, Wooden Baseboard screwed to B and Bench; D, Bench.

The glass for a speculum need not be optically pure, as would be necessary if the lenses of a refracting telescope were being constructed; the reflection being only from the first surface. It depends on the desire of the worker whether the disc be cut from commercial polished plate glass of the requisite thickness, or whether it be specially cast. The former method is preferable, for the glass being polished on both sides a clear disc can be selected, and the polished back not only adds to the general appearance of the finished speculum, but is of slight advantage when silvering.

In the first paper, the question of spherical aberration was discussed, but when we come to the selection of the glass we find another cause of aberration, which however, is much more easily disposed of. This cause is flexure. If, for example, a 6 inch mirror was constructed of glass only one-quarter of an inch thick, it would be difficult to support it properly, either during the working or in the telescope when completed. The least bending of its surface would throw the reflected rays out of their true paths, and so destroy the purity of the definition. To avoid all risk of error from this cause, it is only necessary that we should secure glass of thickness sufficient to resist any slight strain to which it may be subjected, either in the processes of working or when completed; and for this purpose we cannot do better than follow the same rule as the professional artists. For specula from $4\frac{1}{2}$ to 12 inches in diameter, it will be practically safe to use glass in thickness not less than one-sixth of the dia-

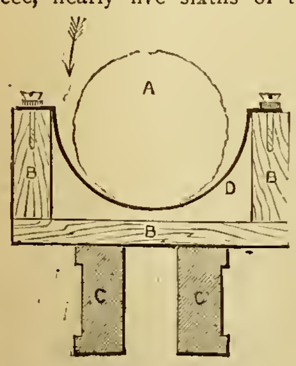


FIG. 22.—WOODEN FRAME ON LATHE BED. A, Glass Disc; B,B,B, Wooden Frame; C, Lathe Bed; D, Hoop Iron.

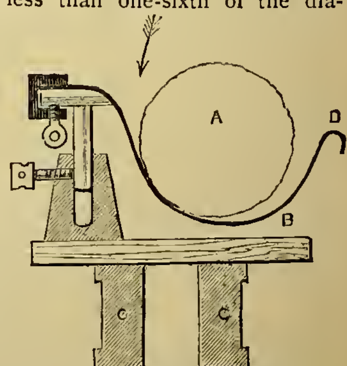


FIG. 23.—HOOP IRON CLAMPED TO T-REST. A, Glass Disc; B, Hoop Iron; C, Lathe Bed.

FIG. 19.—SPECULUM GRINDER'S WORKSHOP WITH WORKMAN IN POSITION AT BENCH.

meter of the speculum; above 12 inches, peculiar methods of support, which need not be described here, are used, obviating the necessity for maintaining that proportion. According to the preceding rule, a $6\frac{1}{2}$ inch speculum will require to be about one inch and a quarter in thickness. Should it be more convenient for the reader to use thinner material, he may safely venture upon the manufacture of a speculum of that diameter, from glass, only three-quarters of an inch or an inch thick Special precaution, however, should in the latter case be made to secure even support to both speculum and tool, and the metal backing to which the former is cemented should be of the same diameter as the speculum. Still, it is advisable to place flexure at defiance by obtaining and using glass even thicker than that used by professional opticians.

Plate-glass can be obtained from the manufacturers either polished on both sides or unpolished, of varying thickness, from $\frac{1}{8}$ inch to $1\frac{1}{2}$ inches, so that up to 9 inches in diameter the amateur may obtain his supply from this source. Above that diameter the disc may be specially cast. For our $6\frac{1}{2}$ inch speculum, a disc $1\frac{1}{2}$ inches in thickness should be obtained. In the cutting, a square piece of plate-glass having been selected, the required circle is marked on both sides with a cutting diamond, and the superfluous glass broken away. This leaves the edges rough and jagged, which would afford a resting-place for grit, and cause scratches in the working, so that they should be at once ground smooth. If the amateur has a lathe this can be easily done with a little labour, but if with the writer he objects to laborious work, the glass merchant will grind the disc to a fair circle, and fine or polish it as desired upon his wheels. Care should be taken to paste on to the glass a paper pattern $6\frac{1}{2}$ inches in diameter, for the glass grinder works with a large stone wheel set on a vertical mandrel, holding the glass in his hands, and merely grinding it to an approximate circle, unless a definite pattern is given. Apropos of this stone wheel, it may be mentioned that a large grindstone quickly reduces the edge of the glass to a smooth condition, so that the worker may be his own rough glass grinder if circumstances permit. The glass disc for the tool should be treated in a similar manner to that intended for the speculum, except that it will require no fine grinding.

An excellent result can be obtained without further finishing the edge, but it is desirable to centre the disc in a lathe and grind it perfectly true. If the lathe be too small to take a disc $6\frac{1}{2}$ inches in diameter, the difficulty may be easily overcome by reversing the head-stock, so that the face-plate and glass may overhang the edge and run clear of the lathe bed. As the method of finishing is identical with that necessary if the disc is treated by the amateur from the moment it leaves the glass-cutter's hand, I will describe it.

The artist has shown in Fig. 19 a disc roughly mounted in the lathe for grinding. This will give the reader a notion of the general arrangement, and I may mention here that it is advisable to use an old lathe in preference to a good one, and that the bearings and parts of the machine not required for one's immediate purpose, should be carefully protected from the wet emery. Procure a disc of wood about 2 inches less in diameter than the glass disc. Screw this firmly to a face-plate of convenient size, and roughly score a number of rings in the revolving wooden surface to afford the cement (pitch) a strong hold. Take one cut across the scored surface to true it, and then having covered it with successive layers of hot pitch to the depth of about $\frac{1}{8}$ inch, press it firmly and centrally upon the glass, which should be previously slightly warmed. The glass should be thoroughly dry and the pitch almost liquid, or they will not adhere one to the other. The centring of the glass should be completed in the lathe with care, but rapidly, before the pitch has set hard. It can be at once seen through the glass if the pitch has adhered at every part. When the face of the disc runs true in the lathe, it should be removed necessarily with the face-plate, and set aside to cool for several hours face downwards.

The glass is cut by the aid of sand or emery. A material in which these substances can be embedded is required, and for this purpose we will use soft iron. There are several methods of placing the iron in contact with the revolving glass, but the simplest are those shown below. In the first instance a wooden frame, as shown in Fig. 22, is made to rest on the lathe-bed below. A piece of hoop iron about 2 inches wide and of a suitable length, is well baked to soften it, bent to the required curve, and screwed to the wooden uprights A, B. It should be so placed that that part of the edge of the glass most out of truth, as ascertained by revolving the lathe slowly, will just touch it.

As the irregularities of the glass are cut away, the iron is raised by the interposition of a thin wedge between the wooden frame and the lathe bed. In the second instance, Fig. 23, the hoop iron is hooked over and clamped to the T-rest of the lathe. The metal band is free at the other end, and will touch the glass for a very small distance, as shown.

If the disc is very rough, this method is perhaps preferable to the former, for the iron may be allowed to spring against the glass until the roughness is reduced. On the contrary, however, if the edge is already ground by the glass grinder, the metal may

be with advantage fixed. The curve in the metal at D allows the band to be occasionally raised to touch the revolving glass, and so remove any surplus emery which may have accumulated at B. At the latter point the partly-used emery escapes, and a shallow vessel should be placed below to receive it for immediate use again. The emery must first be soaked with water, and should then be fed down regularly between the glass and the metal in the direction indicated by the arrow.

When removing the rough edge, sand or very coarse (40 hole) emery must be used, and the speed of the lathe kept well under; but for finishing, it may be run at a greater speed and a finer grade or flour emery applied. The sharp edge of the glass should be slightly bevelled either by holding the metal band at an angle with the glass and using fine emery, or by the use of a piece of sand-stone. If this is done during the earlier parts of the process, it will prevent the face of the glass chipping, an accident not unlikely, otherwise, to occur. Water will be required during the process, but as the demand will vary according to the amount of moisture left on the emery, it is best supplied from an ordinary oil can, which, as it will be again required, should be purchased and reserved for water only.

Avoid driving the lathe even for a few turns in a reverse direction, or the face-plate by reason of the weight of the glass attached to it may become unscrewed and fall.

By these methods the writer has obtained neatly fined edges, a source of considerable gratification when the speculum is completed. The glass disc should never be placed on the small bench except there be ample room, but on some handy shelf where its safety will not be endangered by the movements of the worker.

In concluding this paper it may be desirable to say that the full-page cut in Fig. 19 has been reproduced in fac-simile from a drawing* expressly executed by a friend of the writer to illustrate more especially the position of the workman, and how he should hold the disc when engaged in speculum grinding.

(*To be continued.*)

* I desire to direct the attention of contributors to Fig. 19, to which allusion is made here, and to the two illustrations shown in Figs. 18 and 19, in "Etching on Copper," of which the latter have been reproduced from Mr. Chasemore's original drawings. I wish to illustrate the various papers in AMATEUR WORK with the original drawings of their respective authors, and to this end I will be glad if writers who can draw will send with their articles diagrams and drawings, carefully executed in pen and ink, for reproduction from the sketches themselves. A paper or two will shortly appear on this subject, giving full instructions on the *modus operandi* that must be adopted and followed.—ED.

CLOCK CLEANING AND REPAIRING AT HOME.

By OLLA PODRIDA.

I.—INTRODUCTION—THIRTY-HOUR CLOCK—ANALYSIS OF THE MOVEMENT—ALARUM.

BEING but a humble amateur under these colours, it is with much fear and trembling therefore that I venture to re-open a subject long closed up, and only do so in the hope that my limited experience may prove to be some assistance in this line amongst my brother amateurs.

Not being a "professional" man, the style of this and the succeeding papers will necessarily be homely, and free from exclusive technicality. But this I would point out is an advantage in speaking "amateurly" one to another. The "professional" too often overlooks the fact that bare technicalisms frequently prove serious drawbacks to the acquisition of knowledge by amateurs. This it will be my object to avoid, or if technical terms are employed, care will be taken to ensure that they are well backed up with full and simple explanations, so that every chance may be given to the reader, thereby enabling him to readily recognize the part under description.

Clocks, like the "plans of mice and men, gang aft a-gley," the cause being frequently of a very simple nature, which might, with a little knowledge, often be prevented, or readily removed at home without calling in the assistance of the "pro," who frequently makes a good market on most slender foundations. This, more especially amongst country clocks, where the itinerant clock-tinker rules and reaps a harvest. I say "rules," because in the absence of any knowledge to the contrary, *his* word is law. It is all very well in the case of the regular caller, who is well-known and is paid yearly for keeping the timekeeper in order, but in the case of the "casual" it is different. Perhaps the clock stops. Some trifle the matter. The "casual" happens to turn up, and his proffered services are accepted rather than wait for the "regular" man. And the clock is seldom benefited greatly. And no wonder. I have known some of these casuals to go through a most pretentious examination accompanied with a wonderfully limited amount of disintegration, and after imparting about ten minutes' worth of their own superfluous energy to the pendulum, pocket their fee, and quit "sharp" for "greener fields and pastures new," wherein they may gull some other guileless clock owner. As a matter of course, the practical knowledge of such sharpers is *nil*, or a scanty smattering at the best.

But the greatest danger lies in the unscrupulous

"professional." To some of these but little is too hot or heavy. I have known cases where after a "professional" visit by some of these gentlemen, the family clock when weighed in the balance has been found sadly wanting. In some the moon—frequently met in the "long case" clock—has stubbornly refused to expose or diminish her wonted fulness, owing to the surreptitious removal of certain vital parts of her internal economy.

I remember one case in particular when, after being ostentatiously cleaned and restored, the clock stubbornly refused to go on "strike." "Winding up' wasn't any good, in fact, was out of the question, there being nothing to hang the key upon. Except this, everything appeared to be all right externally. There was the weight and cord hanging quite naturally, but nothing to wind it up with. A closer examination revealed the fact that the striking movement—except the weight, cord, and bell—had vanished bodily, probably for the benefit of some other afflicted clock. Perhaps some reader will opine that the foregoing is

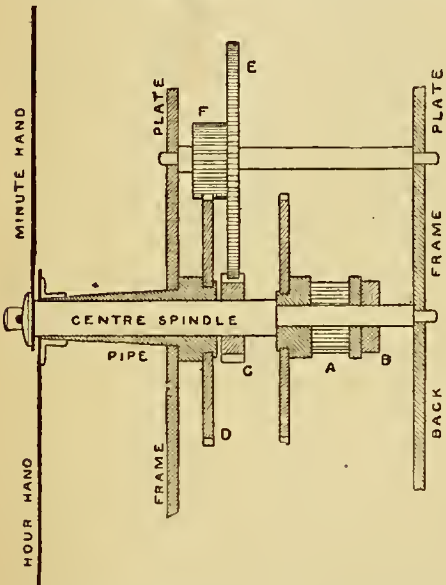


FIG. 2.—SECTION THROUGH CENTRE SPINDLE.

rather overdrawn. Nothing of the sort, the case is not an imaginary one, for the writer was an eye-witness —in fact, formed one of the jury at the inquest.

But it must not be credited that all clock jobbers are tarred with the same brush. Far from it, there are rogues in every trade, as is well-known. I have only cited a few instances that the amateur, or clock proprietor may become cognisant that such things happen sometimes, and, forewarned being forearmed, put him on guard. To this end I trust these papers will answer the purpose intended, and be the means of promoting the formation of an acquaintance sufficiently intimate with the subject as shall enable the amateur to do his own cleaning at least, which will be by far the best safeguard against any marauding jobber.

I shall confine myself exclusively to those types of clocks which are most frequently met with in the home. Overhauling, cleaning, and the best means of

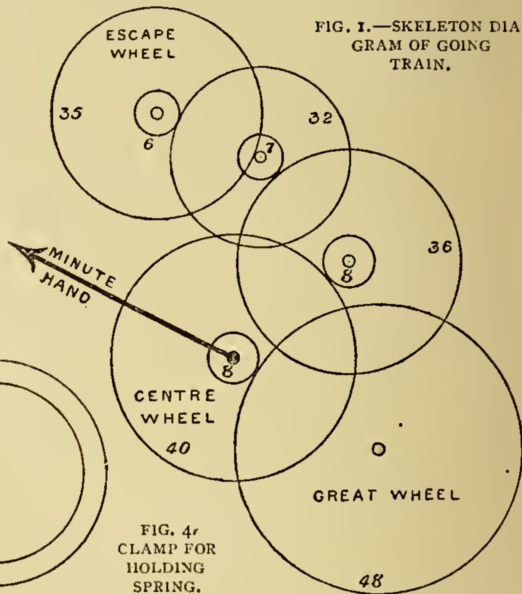


FIG. 1.—SKELETON DIAGRAM OF GOING TRAIN.

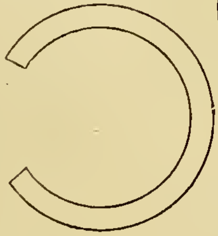


FIG. 4. CLAMP FOR HOLDING SPRING.

executing such repairs as may be accomplished at home by the amateur of limited resources, will be fully treated.

We will commence with the familiar American thirty-hour class. This type is in very common use, both with and without the alarum, which will, however, be included in our example. There are many different styles or makes of these clocks. Each manufacturer has his own particular arrangement, but the result arrived at is the same. They run thirty hours or more, and divide time with—considering the prices —great impartiality.

It will not be out of place, and may be of assistance, if we investigate the working of this clock with the aid of a skeleton diagram, in which the wheels are represented by circles, having the corresponding numbers of teeth marked upon them.

On reference to this diagram, Fig. 1, it will be seen that a hand or pointer of conventional form is shown attached to the centre of the circle marked 40, which is the number of teeth in the wheel on the spindle carrying the minute hand. This spindle is known as the "centre" spindle, and the wheel and pinion, "centre" wheel or pinion, as the case may be.

We know that the minute hand of a clock makes one complete revolution in an hour. If we start from this basis, knowing the numbers of teeth in the different wheels and pinions forming the "train," as the whole series is called, it becomes an easy matter to find out the result of the movement as a whole, or the relative movement of each separate "arbor" or spindle.

Supposing that it is wished to know how many revolutions the escape wheel makes in one hour, or during the time it takes the minute hand to make one revolution, we proceed as follows:—

The "centre" wheel —40—making one revolution per hour, drives a pinion—8—on the next or second spindle, which therefore turns $\frac{40}{8}$, equals five times per hour, or five times faster than the centre spindle. On the second spindle, another wheel —36—is fixed, and, as a matter of course, turns at the same rate as the 8 pinion (five times per hour), and drives a pinion—7—on the third spindle. The second wheel having 36 teeth, and the third pinion, gearing with it, 7 teeth, it follows that the third pinion makes $\frac{36}{7}$, or $5\frac{1}{7}$ turns for every one turn of the second wheel, which, making five turns per hour, causes the third pinion therefore, to make $5\frac{1}{7}$ by 5, or $25\frac{5}{7}$ turns in the same time. On the third spindle, a wheel—32—is fixed, gearing with a pinion—6—on the escape wheel spindle. The escape pinion—6—therefore turns $\frac{32}{6}$, or $5\frac{1}{3}$ times faster than the third wheel, which turns $25\frac{5}{7}$ times per hour, thereby causing the escape pinion to turn $5\frac{1}{3}$ by $25\frac{5}{7}$, or $137\frac{1}{7}$ times per hour. The escape wheel, being fixed to the same spindle, therefore turns $137\frac{1}{7}$ times in an hour, or $137\frac{1}{7}$ times faster than the minute hand.

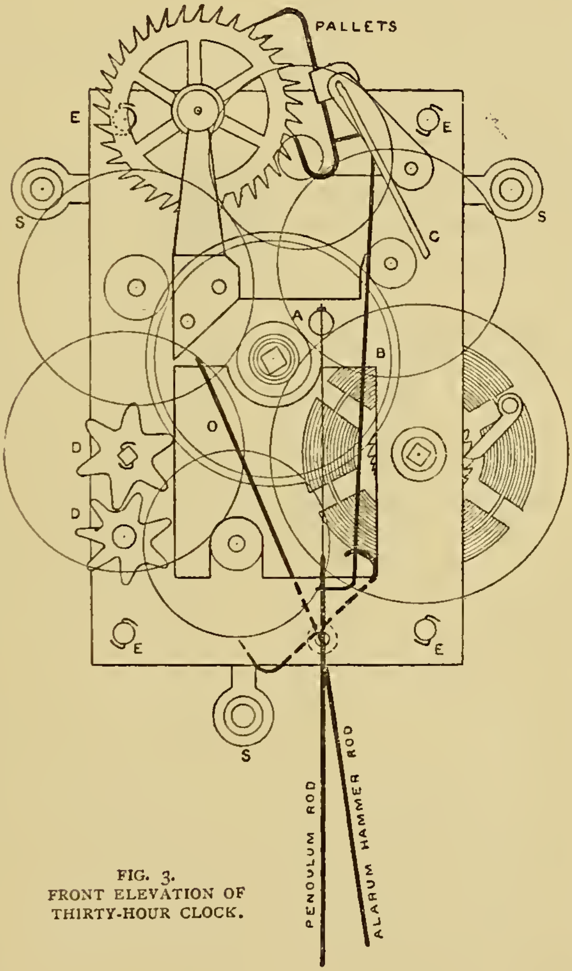


FIG. 3.
FRONT ELEVATION OF THIRTY-HOUR CLOCK.

We can now, if desired, find what time the pendulum "beats," or the time occupied by a complete swing, necessary to effect the release of one tooth of the escape wheel. This wheel in the case before us has 35 teeth, and makes $137\frac{1}{7}$ turns per hour. Therefore, the number of teeth which pass through the pallets, or are acted upon by the pendulum in that time, equals 35 by $137\frac{1}{7}$, or 4800. In one minute $\frac{4800}{60}$, or 80 teeth, will have passed, and in one second, $\frac{80}{60}$, or $1\frac{1}{3}$ teeth. It will now easily be seen that one tooth takes three-quarters of a second to pass, or, in other words, the pendulum "beats" three-quarter seconds in this clock, and "ticks" 160 times per minute, it taking two ticks to release one tooth.

We will now further investigate the works in the direction of the motive power. There are 48 teeth in the "great" wheel, which is connected to the spring. Cords and weights are not—to the best of my knowledge—used in this small type of clock. The "great" wheel—48 —gears with a pinion of 8 teeth on the centre spindle. Therefore, one turn of the great wheel produces $\frac{48}{8}$, or six turns of the centre pinion and minute hand spindle, or, in other words, it takes six hours for the great wheel to accomplish one revolution. In order that the clock may run for its specified time—thirty hours—the spring must be capable of carrying the great wheel round five times. There is generally a good margin allowed. As a rule, these clocks will run for about thirty-six, and sometimes forty hours, without material loss, if the works are in good going order. When a Geneva stop, or some similar contrivance is fitted, of course the run of the spring is limited to the length or duration of the stop. These stops, generally used in the better class of

clocks, will be described in due course, when their turn comes. A simple form will be found in connection with the alarum of the clock under notice.

The relative motion of the hour and minute hands is accomplished by means of an independent arrangement, or train of wheels and pinions. This will be explained and clearly understood by the aid of Fig. 2, which is a sectional sketch through the centre spindle. The pinion A receives motion from the great wheel —not shown—and communicates it to the spindle by means of the friction between it and the "collet," collar, or washer B, which is driven tightly on the spindle and hard against the end of the pinion. The pinion C is fixed to the spindle, but the "hour" wheel D, and its pipe or tube ride loosely upon it. The alarum disc fits tightly upon this tube, between the hour hand and the front plate of the clock frame. The wheel E gearing with the pinion C, and the pinion F gearing with the hour wheel D, are (E and F) carried by an independent spindle, as shown. Frequently they are carried on a stud fixed in the front plate. It makes no difference, the result is the same, viz., the reduction of the motion of the hour hand to one-twelfth that of the minute hand, or spindle.

Let us now examine this motion. The pinion A has 12 teeth, and gears into E which has 36 teeth. A turns once an hour, therefore E turns $\frac{12}{36}$, or $\frac{1}{3}$ of a revolution in the same time. E being fixed to the pinion F, their motion is the same. F has 10 teeth, and gears with the hour wheel D, which has 40 teeth. The relative motion of D to F is therefore $\frac{10}{40}$ or $\frac{1}{4}$ of F, and F turns $\frac{1}{3}$ of a revolution in an hour, therefore D turns $\frac{1}{4}$ of $\frac{1}{3}$, or $\frac{1}{12}$ of a revolution in an hour, which being the relative motion of the minute and hour hand, is the desired result.

Just a word, in passing on the alarum movement. This consists of a spring, "great" wheel, pinion, and a species of triangular toothed escape wheel, mounted with the pinion upon a separate spindle. The great wheel has, in this case, 40 teeth, and drives a pinion of 7 teeth on the escape or striking wheel spindle. The striking wheel acts on pallets, very similar to those in the going train, except that they are stronger and have on the end of the wire, corresponding to the crutch, a hammer head instead of an eye. A wire lever extends from the pallet spindle up to the alarum disc, or hour wheel pipe. This disc has a notch cut in its circumference in such a position that the bent end of wire lever may drop into it when the figures on the disc correspond with those on the clock dial. This notch is of sufficient depth to allow the pallets free play when the bent lever drops into it. The plain edge of the disc, by pressing on the bent end, keeps the upper pallet tight into one of the striking wheel teeth, or, more correctly, spaces, and thus prevents it from acting or running down until the notch releases the lever. In setting the alarum, it must not be wound up until *within* twelve hours of the required time.

The taking to pieces, cleaning, and restoring of the above type of clock, will be entered upon and treated fully in the next chapter.

(To be continued.)

HANDY WORK IN FARM AND GARDEN.

By GEORGE EDWINSON.

XII.—WELLS, TANKS, AND WATERWORKS.

THE late dry summer has demonstrated to us dwellers in the changeful climate of England, the necessity of a system of waterworks on a farm. During several subsequent summers our farmers have suffered from an excess of moisture on their lands, and may therefore be excused if they have neglected to provide for such contingencies as a hot dry summer nearly approaching a period of drought. To meet such contingencies, however, every farm should be provided with the means of irrigation in addition to an abundant supply of water for drinking purposes. Too often the water supply of a farm and farmyard is sadly neglected. The farmhouse itself is, perhaps, supplied with good drinking water from a well or a pump, but the horses and cattle are not provided with good water. Any water out of a muddy stagnant pool is deemed good enough for them; such pool being exposed to pollution from the excreta of the animals themselves, in addition to that from the fermenting vegetable and lower animal organizations inhabiting such pools. Knowing this, can we wonder at the cause of so much sickness among farm stock, and consequent ill-health to human beings who feed on the products of such animals? On farms in the Home Counties this state of things has now become happily rare, because of an agitation on the part of the milk trade, consequent upon a discovery that impure water supplied to cows tainted the milk, and caused disease in the persons using the milk. If milk can thus be tainted, why not butter and cheese, the products of milk, and also any other animal food product? These are drawn from districts outside the milk trade province, and are therefore not subject to such complete surveillance as those from the district near the metropolis; but it only requires a few moments' thought to determine, that all farmers should be compelled to supply all their cattle at all times with good drinking water. It has been the custom from time immemorial, in the traditions of agriculture, to allow cattle the use of a pond in the

corner of a field, or in the lower part of the farmyard, in which they can slake their tbirst at will or cool their feet in hot weather. Such ponds are usually mere cesspools, containing the sewage drained from roads and manured fields. They should therefore be filled up and drained, or fenced around to keep the cattle out of them. This does not apply to running streams or ponds through wbich such streams flow.

Drinking Water for Cattle.—This should be provided from a spring, well, or pump ; or from a tank or reservoir supplied by a spring, or from a running stream. When the water is drawn from a running stream, care should be taken to have the inlet free from all danger of pollution. Drinking water for cattle may not be taken from a stream below the farmyard when sucb stream is liable to be polluted with the drainage of tbe yard, tbe farmhouse, or any manured field. If this is rendered unavoidable, on account of the position of the stream to the yard, tben the system of drainage must be altered to avoid pollution of the stream. But, at all times, if at all practicable, secure an inlet from the stream above the farm, convey tbe water to a properly constructed tank or reservoir, and lead it from tbis by means of covered channels or pipes, to stone troughs or similar drinking vessels. In some foreign countries, where springs and streams are few and far between, farmers have to depend on water obtained from tanks specially constructed to receive and retain the natural rainfall. These tanks are connected by means of channels with the gutters surrounding tbe roofs of the farm buildings, and every care is taken to ensure a supply of clean water, which is led through stoneware pipes to cement or stone-lined cisterns underground.

In the colonies of Australia, and especially in New Soutb Wales, the catchment and storage of rain-water for domestic and otber purposes, has attained the rank of a science regulated by well-proved rules. The colonial practice might be adopted in many parts of England with advantage, where a good spread of clean roof is available. It cannot be conveniently adopted on farms near large manufactories consuming a quantity of coal, or contiguous to chemical works, or where pigeons are kept in large numbers, because in such cases the roofs are never clean enough to form a water shed for drinking water. Such roofs may, however, be guttered and spouted to obtain a supply of water for gardens, and the water so obtained will be most suitable for watering the roots of plants. If the farmyard is situated on sloping ground, the water tank should be dug in ground above the level of the yard, and the rain-water should be led to this in stoneware pipes. In any case, if at all practicable, a head should be secured in preference to a pump or well, and the water must be led from the tank in iron pipes. Lead should not be used in conveying rainwater for drinking purposes, because such water contains traces of nitric acid, and this slowly dissolves lead. Stoneware should therefore be used where there is no pressure on the pipes, and iron where stoneware cannot be used. Every tank must be provided with a filter bed ; that is, a shallow tray of stone or concrete erected at one end of tank (as shown in Fig. 145), and filled with clean gravel. To this may be added a layer of broken coke, or of spongy iron, if that is easily obtainable. The rainwater must be made to pass through this bed before it enters the tank, it will then part with some of the sooty impurities carried down from the roofs, and it will also be deprived of much of its organic impurity by contact with the coke. The contents of this bed should be frequently changed, washed, and renewed in rainy weather.

In estimating the size of tank required, it will be necessary to take into consideration the probable number of days when water will be drawn from this source, multiply these by ten to give gallons per head per day, then by the number of animals likely to consume this quantity. This sum, divided by 6·232, will give the required dimensions of the tank in cubic feet. We will suppose, for example, that we are likely to get during the summer one hundred dry days, and we have to provide drinking water for twenty head of animals at a rate of ten gallons per day. We shall therefore require a store of 20,000 gallons of water occupying 3209 cubic feet, and the tank should be made to a size above this to provide a margin for waste, evaporation, and other contingencies. The tank itself may be built of brick, lined with Roman cement to make it water-tight, or of stone, lined in a similar manner, or of slate or other stone slabs securely cemented at the joints, or it may be hewn out of rock, then lined with 6 inches of concrete faced with Roman cement. It should be arched over with brick or stone arches also made water-tight to prevent contamination from the soil above, and securely covered with turf. The water supply should not be drawn from the bottom ; the withdrawal pipes should enter the tank some 4 inches or 6 inches above the level of the bottom to avoid drawing off any sediment tbat may accumulate there after passing the filter. It will be well, however, to provide one pipe at a lower level to draw off the sediment when the tank is cleaned out. Such a tank should provide drinking water not only fit for cattle, but also available for domestic purposes should the usual supply of spring water fail. If an abundance of good spring water is available on the farm, and an adequate perennial supply is always obtainable by means of well or pump, there will be no necessity to construct a tank ; but if drinking water is to be drawn from a river, rivulet, or

other stream flowing through open country, and liable to organic contamination, it will be advisable to pass the supply through a filter bed and into a smaller tank constructed as directed above, in order that the water may be freed from some of its impurities by detention in the filter and settlement in the tank.

Let it be understood, however, that I do not recommend such filtered water as being entirely freed from organic pollution, but the quantity of polluting matter is considerably lessened thereby.* I have given this method of storing water, because it is superior to that of exposure in open reservoirs, since the water stored in these is always liable to contamination from currents of polluted air, and the temperature of the water is always raised to a dangerous point in hot summers. It has been proved that the germs of such epidemical diseases as cholera, are vitalised by immersion in water heated in the summer sun, and persons drinking such water are more liable to attacks of this dread disease than those using water drawn direct from springs and underground reservoirs. This thought, it may be said, should not affect our plans for a system providing drinking water for cattle alone, but when from experience we know that such water is often drank by farm servants, and by others in times of drought, it will be conceded that such a supply should be rendered as pure as possible. It sometimes happens, however, that a farmyard is situated near a running stream deemed pure enough for cattle and ordinary domestic purposes, but not sufficiently pure to provide drinkable water for the human beings on the farm. In such cases as these the water from the stream is made to work a turbine actuating a force pump drawing water from a spring on lower grounds, or it is made to work an hydraulic ram doing similar service. The work of fixing these means for obtaining a supply of drinking water, is of a character demanding the skill of an experienced engineer, so I shall not attempt directions for the purpose in this article. These, together with the apparatus, may be obtained from such firms as that of Messrs. W. H. Bailey and Co., *Albion Pump Works, Salford, Manchester.*

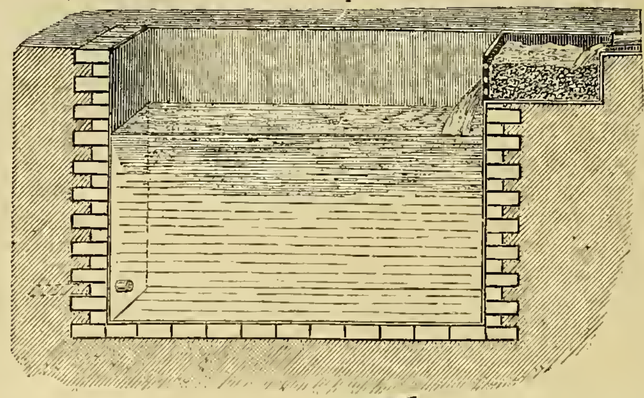


FIG. 145. — TANK OR CISTERN FOR FILTERING AND STORING RAIN-WATER. — SECTION.

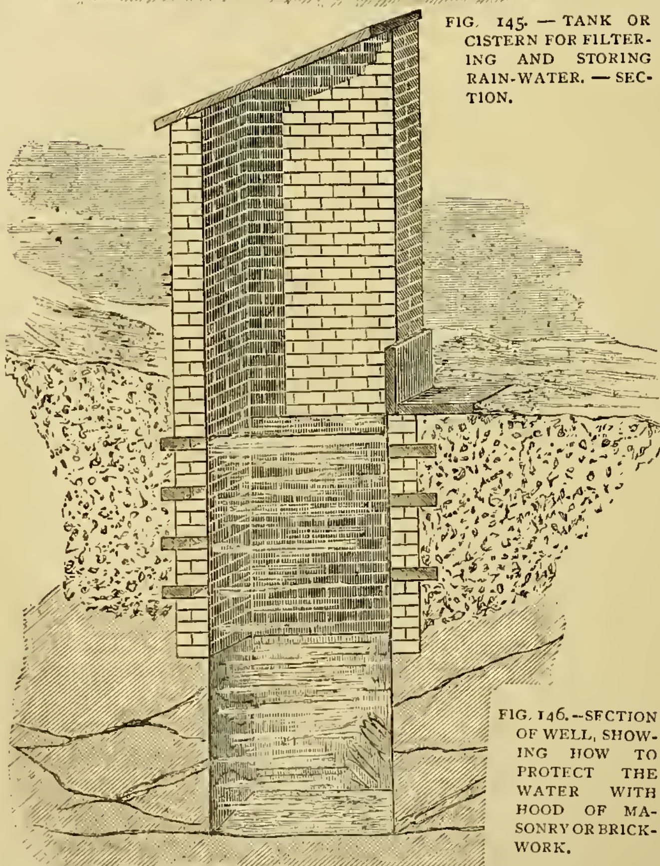


FIG. 146.—SECTION OF WELL, SHOWING HOW TO PROTECT THE WATER WITH HOOD OF MASONRY OR BRICKWORK.

Drinking water for cattle should be led from the tank or other source of supply, to troughs elevated with the edge from two to two and a-half feet above the ground. Wooden troughs lined with zinc will serve the purpose for a short time, but the best, most cleanly and most enduring, are those made of stone, stoneware, or enamelled ironware. In districts where large blocks of granite, marble, and freestone are easily obtainable, troughs cut out of a solid stone block can be readily procured. Troughs

* The presence of organic impurity in water may be detected by means of a solution of permanganate of potash. Add a few drops of this solution to a wineglassful of water. Organic matter is indicated by a brown colouration of the water.

made out of slate slabs, well jointed and clamped with iron, are also to be recommended; but enamelled ironware troughs are now sold at low prices, and should always be used in preference to those made of wood. They can be obtained through all ironmongers, dealers in hardware, and dealers in stable fittings.

Wells and Pumps.—In a previous article on draining land, I showed how the rainfall on certain tracts of land sinks down through the soil and gravel until it reaches a bed of clay, where it forms itself into a pool, or reservoir of water. When such a reservoir overflows, the overflow is named a spring, and the water flowing from it is called spring water. It will be readily understood, however, that the water is merely rainwater filtered through the soil. When such water merely passes through soil, and collects on a bed of impermeable clay or rock, the spring is named a land spring, and the water from it is not wholesome for drinking, because it is usually charged with the products of rotting vegetable and animal matter held in the soil. As rivers are fed to a large extent by land springs, it follows, as a consequence, that water drawn from this source contains much organic impurity. To lessen the quantity of such impurity, the water is passed through filter beds of gravel, spongy iron ore, and charcoal; thus imitating the natural means for cleansing water. When water passes through a bed of sand or gravel, or through a bed of chalk and stones before it is arrested in a natural reservoir beneath the soil, it is deprived of the organic impurities carried down from the soil, and it becomes wholesome spring water fit for drinking. Such water may, and frequently does, contain soluble carbonates, and soluble sulphates of the earthy and mineral matters through which it has passed; but these, with few exceptions, are not injurious to health. It follows, therefore, that the best drinking water is only obtainable from deep reservoirs. In some hilly localities there are frequent and permanent overflows from such deep natural reservoirs, and the work of forming a well is easy, since it is only necessary to dig a deep pit around the natural outlet, and to wall up the sides with masonry or brickwork. It frequently happens, however, that the water finds a natural outlet at a great distance from the spot we have chosen to fix our dwelling, and it becomes necessary to tap the natural channel to this outlet, either by a well cutting into and

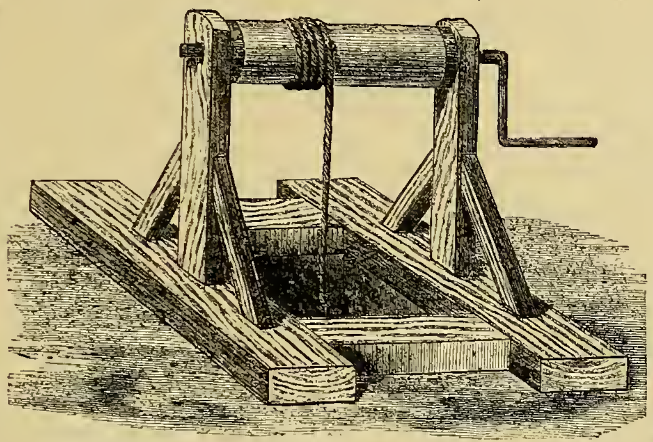


FIG. 148.—COMMON WINDLASS FOR DRAWING WATER FROM DEEP WELLS.

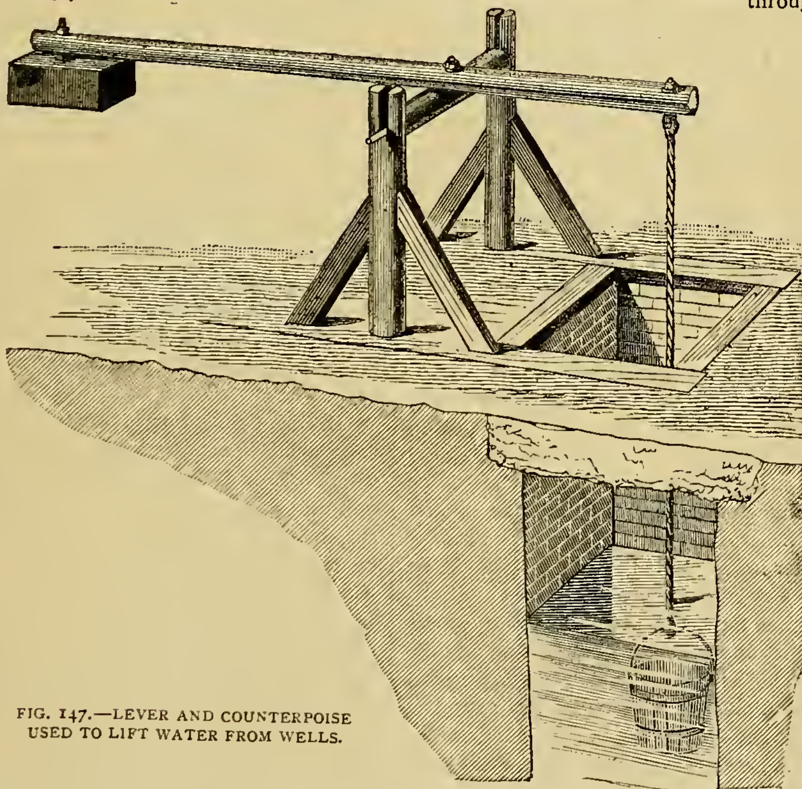


FIG. 147.—LEVER AND COUNTERPOISE USED TO LIFT WATER FROM WELLS.

entirely diverting the channel or by one deep enough to attract, by its lower level, the water from the channel, or the reservoir itself. The success of undertakings to find water in this way is greatly enhanced by a knowledge of the geological formation of the district, and this should be well studied by the amateur well-sinker before he attempts the arduous task of sinking a well. Well sinking should only be attempted by an amateur when he is certain that the well need not be carried to a greater depth than 12 feet below the surface, and, if necessary to carry it to this depth, or nearly so, that the soil can be safely excavated.

It is dangerous work to inexperienced persons when the soil is loose and sandy, and also when reservoirs or channels of water in great volume may be struck at a great depth below the surface. All such work should be left to the professional well-sinker; but there are many opportunities for amateur exercise in providing wells where now only a natural pit exists, or the water bubbles up through a hole in the earth, or trickles down the face of a bank or cliff, or oozes out through crevices in a rock. It should be understood, however, at starting, that the water found bubbling up through the earth in wet seasons near a farmyard, private dwelling, garden, or cultivated field, may be only a land spring heavily charged with sewage, although it may appear clear and bright. The same may be said of water collected in a natural pit or hole near such places, and also streams trickling down a bank nearly below such situations, or near a churchyard. All such sources of water for drinking must be avoided.

When it is desired to convert a hole or a natural water-pit into a well (and this should always be done before water is drawn from it for drinking purposes), we must first dip or pump out all the water, or sink a well near the water-pit, and divert the water into the well. If the volume of water flowing into the natural pit is large, the latter course will be advisable; but the level of the water in the neighbouring pit should be kept low as the new pit is deepened.

The excavation for a new well should not be less than 3 feet square, or a space in which a man can use a pick and shovel. The implements used, are a pick, commonly called a pickaxe, a short-handled shovel, a crowbar, and a strong wooden pail. At first, the broken ground is easily thrown out with a shovel, but when the excavation is too deep to allow of this being done, the workman must fill the rubbish into the pail, and it must be drawn to the surface with a rope, by means of an assistant. As the well becomes still deeper, a windlass is erected over the excavation, and the material passed up and down in pails by this means, and the sides must also be protected from collapse by a shoring of planks as the work proceeds.

When the well has been sunk deep enough to ensure a firm foundation for the masonry, or has been carried down below the loose permeable surface soil or strata, it will be advisable to face up the sides with masonry or brick work. Coursed work with thin narrow stones, jointed with Roman cement, will be found best, since the main object is to keep out of the well direct surface water. Choose a good firm ledge for the foundation, and line the upper part of the well with masonry before it is carried deeper into the rock.

As the work proceeds and the loose ground is reached, put in a long tie at intervals, in the shape of a long stone, or a brick inserted lengthwise into the side of the pit. When the lining has been carried to the surface, the well may be further deepened until it is deemed deep enough, or water has been struck in sufficient quantity to advise an abandonment of the work of excavation. The finishing strokes in search of water can be done with the crowbar, and this tool will be used to make a connection between the natural pit and the well.

When the well has been completed, the adjoining pit should be filled up with the soil excavated from the well. If the water rises in the well high enough to admit of it being dipped out with pitchers and pails, the well should be covered with a hood of masonry to prevent heating by the direct rays of the sun, and also to exclude dust and other polluting substances. The mouth of the well should also be guarded with a slab of stone, as shown in Fig. 146, and another slab of stone should be laid flat in front, as a dripping stone on which to stand the full pails.

Drainage must not be forgotten. The surrounding soil should be removed until the surface slopes away from the mouth of the well, and a drain must be laid up to the edge of the dripping stone, to take away all surplus and surface water. Similar precautions should be taken, and the work carried out in detail, in a similar manner, when a well has to be dug near a spring. The well is dug near the natural outlet, and this is tapped or diverted to flow into the bottom of the well. Wells dug in the side of a cliff or bank, should have a hood of masonry built into the bank over the well to exclude surface water. In all cases, water should be made to go down through several feet of gravelly or sandy soil before it enters the well.

Water is drawn from deep wells by means of a long rope attached to a light wooden pail thrown in and drawn up by hand; or by means of a pail hung by a rope to a balanced lever (see Fig. 147); or by means of a rope and pail actuated by a windlass as

shown in Fig. 148; or by means of a pump. The first method can only be used as a temporary means in times of drought, when the water in an ordinary well falls below the dipping level. The second method is only applicable when the surface of the water does not rise higher than to within 6 or 7 feet of the ground surface. The third method must be used when the surface of the water in the well falls too low to be reached by means of the second method. The fourth method is best left in professional hands for the present; but at some future time, if so desired by a sufficient number of readers, I may show how amateurs may make, and keep in order, the domestic pump.*

When a well can be sunk in rising ground, a short distance from a farm or hamlet (say not more than half a mile distant), and it promises to supply a good volume of water, it is advisable to convert it into a large underground reservoir, constructed as directed for rain-water tanks. Two mains should lead from this to the farm. The high level or overflow main should discharge its water by means of a spout, into the water trough system for the cattle, whilst the low level main should be of strong iron pipes connected with pipes and taps laid on to the dwelling-houses. Such a source of water supply for country places is all that can be desired both in summer and winter.

I have dwelt all the longer on this subject because of its importance; but I must now close this paper with much unsaid. I have not been able to treat of other waterworks on a farm, such as millponds, water-wheels, irrigating ponds, sluices, leats, channels, etc., etc. With this paper I bring the series of "Handy Work on Farm and Garden" articles to a close, but I have not exhausted the subject. At some future time I may give some special articles on Handy Work, and I shall always be pleased to hear from interested readers desiring information on farm and garden work. Short replies to questions on these subjects will be given in the section devoted to Amateurs in Council.

It is with much interest that I have read in this portion of the Magazine inquiries from settlers in some of our Colonies, with reference to the methods of utilizing water-power; and it is to such as these that I trust this chapter will be especially useful, touching as it does on the closely allied subject of the collection and storage of water, and the means of drawing it up for use when thus collected. It is scarcely necessary to add that these papers have been written for my fellow countrymen abroad as well as for those at home, and I sincerely trust that all I have advanced will prove both instructive and helpful to them.

* An illustrated description of the Abyssinian Tube Well or Pump, and how to fix it, will be found in "Every Man his own Mechanic," pp. 529-531.

GLASS-BLOWING FOR AMATEURS.

By ALFRED W. SOWARD.

III.—BLOWING MACHINES—MANIPULATION.

OF the many varieties of blowing machines before the public, Mr. Fletcher's foot-blower is undoubtedly the best. It is represented in Figs. 19 and 20, and consists of an ordinary pair of bellows communicating, by a valve opening outwards, with a collapsible air chamber of sheet india-rubber. The air is stored in the collapsible chamber, and is driven forth through the nozzle in a regular stream by the elasticity of the rubber. A network prevents rupture of the rubber from undue distension. Other forms of the blower are shown in Figs. 21 and 22. The first has the rubber chamber placed beneath the bellows, so that it may be less exposed to risk of injury, and the second has the chamber quite separate from the bellows.

Tilley's water blowing machine, although not nearly so convenient as Mr. Fletcher's contrivance, has the advantage of being easily constructed by the amateur, and, therefore, appeals to those who, from small means or from preference, are restricted to the produce of their own workmanship. The machine is sketched in Fig. 23. It consists of an outer case, divided by a vertical partition into two compartments, which are air and water-tight with reference to one another, save at the bottom of the partition. The compartment A is open at the top; the compartment B has an air-tight cover pierced by two tubes, C and D, the one just passing through the cover, and terminating exteriorly with an air nozzle E, the other reaching nearly to the bottom of the case, and being provided outside with an elastic tube and a mouthpiece F. Sufficient water is poured into the compartment A to half fill the whole case. When the water is first poured in it will stand at a higher level in A than in B, as is shown in the sketch; but as the air is forced out through the nozzle E, the water will rise in B and sink in A, and this will continue until the level of the water is the same in the two compartments, when the blast of air will cease. The mouth is then applied to the mouthpiece F, and air is driven into B from the lungs; the process is thus reversed, and the water sinks in B and rises in A. On removing the mouth, the water again sinks in A and rises in B, and so on. If care is taken never to allow the water in the compartments to become level before blowing in air, the blast from the air nozzle may be maintained for any length of time. A gauge G is very useful in enabling this to be done. A mark H shows the position of equilibrium, and whenever the water sinks to nearly this point, air is blown in.

The machine may be made of tin plate, or, more economically, of an old wooden packing-case, carefully coated on the inside, and rendered water and air-tight, with marine glue, or some other compound of like nature.

An even more homely contrivance is the glass-blower's table, shown in Fig. 24, wherein the blast is produced by a pair of ordinary kitchen bellows. The bellows are placed on the ground, and worked by the foot, and a spiral spring separates their handles when the pressure of the foot is released. Pieces of wood support the bellows at a distance of about an inch from the floor, and the ingress of air is thus permitted to the valve. From the nozzle of the bellows an india-rubber tube leads to a wooden box A, which contains a valve opening upwards. The air from the bellows, when the foot is depressed, raises this valve, and flows on through the box and the india-rubber tube B to the nozzle C; but part of the air flows through the side tube to the bladder D, and is there stored. This bladder, when the apparatus is in use, is covered with a cloth weighted at the sides, so that the bladder is constantly under pressure. When the upper board of the bellows is released from the pressure of the foot, the valve in the wooden box closes, and the blast of air is maintained from the store in the bladder, whence the air is expelled by the pressure of the weighted cloth.

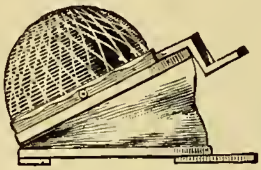


FIG. 19.—FLETCHER'S FOOT-BLOWER—ORDINARY PATTERN.

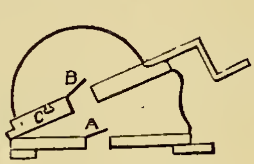


FIG. 20.—SECTION OF FOOT-BLOWER IN FIG. 19.

A, B, Valves; C, Tube leading to Nozzle.

FIG. 26.—PRINCE RUPERT'S DROP.

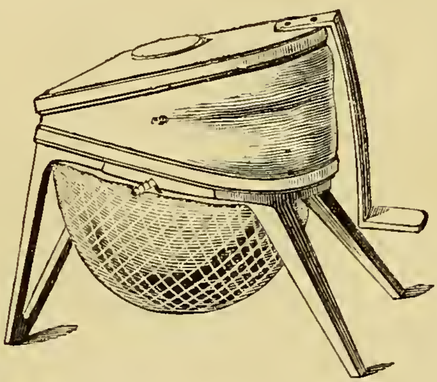


FIG. 21. — FLETCHER'S FOOT-BLOWER. — IMPROVED PATTERN, WITH AIR CHAMBER SHIELDED FROM RISK OF INJURY.

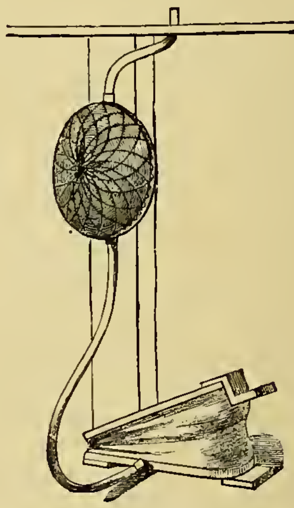


FIG. 22. — FLETCHER'S FOOT-BLOWER, WITH SEPARATE AIR-CHAMBER.

An enlarged view of the wooden box is given in Fig. 25, which shows also the method of making the valve. A piece of oiled silk is selected of a width slightly greater than the diameter of the tube, and is placed loosely over the end of the tube, and is tied there with thread. The degree of looseness is such that air will pass upwards, but when the pressure below is diminished, will be prevented from passing downwards by the adhesion of the silk to the end of the tube. If oiled silk cannot be easily obtained, almost any smooth material, if well woven, may be used, and will answer the purpose.

It will be convenient at this point, before proceeding to actual glass blowing, to study the methods of manipulation necessary for the successful practice of the art. And in this connection the reader is advised, if he can obtain access to the work, to consult the pages of "Faraday's Chemical Manipulation." This work, from the pen of a master of the art of experimentation, is well worthy of attentive perusal; for it is not too much to say that there is no other work in the English language so full of practical information on the subjects of which it treats.

In the first place, as to the source of heat: It should, when a mouth blow-pipe is used, be placed low down upon the table, so that the arm may rest upon, and be supported by, the table, and the operator should accustom himself to holding the blow-pipe with either hand indifferently. If a candle is used, the wick must be kept, by careful snuffing, of a moderate length, and should be inclined slightly to one side. The blast should be directed obliquely upwards, so as to avoid, as much as possible, guttering of the tallow or wax. In the case of an oil lamp, a wick of about one-third of an inch in diameter is suitable, and it should be adjusted until a full smokeless flame is obtained.

In the case of the large lamp used with the mechanical blast, the treadle of the blowing machine is gently worked, and the jet is moved until its nozzle is

a little above the cotton, and just touches the edge of the flame. The force of the blast must then be so arranged that the flame is made to assume the direction of the jet without any curling up of its tip. Frequently, owing to weakness of the blast, this is not possible, and the jet must then be advanced into the flame. A part of the flame only will be then thrown forward, and the remainder will rise upwards. This latter portion must be caught in the conical hood of the lamp, so that the smoke may be intercepted, and the dazzling effect of the light upon the eyes prevented. The flame obtained must be very steady and devoid of all "roar." The part of it touching the wick is luminous, but the greater portion is almost non-luminous, and of a dark blue colour. Its conical tip is coated with a pale yellow mantle, and beyond the extremity of the visible flame is a region of intensely heated air.

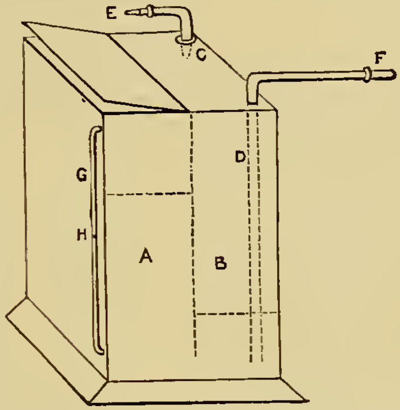


FIG. 23.—TILLEY'S WATER BLOWING MACHINE.
A, B, Water Compartments; C, Short Pipe leading to Air Nozzle E; D, Long Pipe with Mouthpiece F; G, Gauge to show height of Water in A; H, Mark showing Level of Water at which Blast will cease.

It is necessary that the operator should study the properties of the different parts of the flame. With this object, he should procure a piece of well-burnt charcoal, and should scoop a hemispherical recess in it, near one extremity. Instruments are sold for this latter purpose, but the end of a *closed* pocket-knife answers equally well. Into the recess thus formed, a piece of metallic tin is placed (not tin-plate, which is iron coated with a thin film of tin), and the metal is exposed to the several portions of the flame in succession. It will be noticed that when the metal is completely enveloped in flame, it remains bright, but that when it is moved so that although still bathed in flame and acted on by intense heat, it is yet exposed to the air, it becomes partially, or it may even be entirely, converted into a yellowish-white, earthy-looking, solid, and that this solid, when enveloped in flame as the tin was at first, becomes transformed again into lustrous metal. This experiment should be repeated again and again, until the operator is able, with certainty, to preserve the molten tin in the metallic state, or to obtain the earthy-looking solid. The explanation of the change is this—the fuel needs oxygen for the support of its combustion, and the requisite oxygen is supplied by the air. At the surface of contact of the flame with the air, oxygen is plentiful, whilst in the interior of the flame the oxygen has all been burnt. At a high temperature, tin, like most bodies, will, if exposed to the air, rapidly combine with oxygen to form a "rust," or oxide, and this oxide, if exposed, also at a high temperature, to gases eager to burn, will part with its oxygen, and become metal again. The application in glass-blowing of this fact, is as follows:—

Soft flint glass contains lead, and when heated in the reducing part of the blow-pipe flame, becomes blackened, owing to the separation in the mass of the glass of minute particles of metallic lead. Great care has therefore to be used in the manipulation of this variety of glass, in order to avoid, if possible, the objectionable discoloration in question, or if, by accident, reduction of lead is produced, then, by a skilful application of the oxidising portion of the flame, the metal must be burnt up. The alternate discoloration and clearing of flint glass should be practised until complete mastery of the flame is obtained. But it must be observed that if the amount of discoloration be large, it cannot be removed, even by a skilful operator.

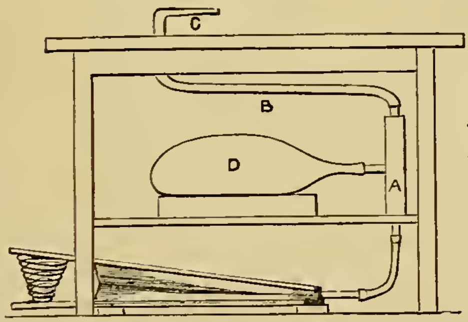


FIG. 24.—HOME-MADE GLASS-BLOWER'S TABLE.
For description, see Text.

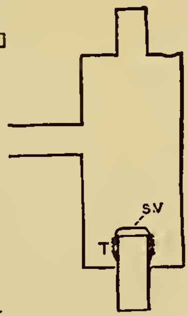


FIG. 25.—SECTION OF A, FIG. 24.
S.V, Silver Valve; T, Thread Binding.

Another important point to study is the relative temperatures of the different parts of the flame, and the effect upon the temperature of altering the relative supply of fuel and air. A little square of platinum held by a pair of small tongs is very useful in doing this. The platinum is placed in the flame, and moved about from end to end, and into the air beyond the tip of the flame. The relative temperatures may be

judged approximately by the different degrees of incandescence to which the platinum is raised. In exploring that part of the zone of heated air in which the platinum is not raised to redness, a piece of thin paper may be used, and the degree of heating be determined by the depth of colour produced by the charring of the paper.

It will be found that the flame is hotter on its surface than in its interior, and is hottest towards its tip. The interior of the flame near the base—that is, near the wick—will be found to be comparatively cold. The mantle of air surrounding the flame will be found to become hotter from the base of the flame to the apex, and it will be found that the current of air beyond the tip of the visible flame, in the axis of the blast, is heated for a considerable distance. When the temperatures of the different parts of the flame have been mapped out in the mind, practice should be had with odd pieces of glass until the operator has acquired proficiency in the management of the flame, as shown by the power of producing and maintaining any desired temperature. A piece of glass should be heated until it is soft, and it should then be kept for some minutes at the same degree of red heat and of softness. It should next be moved to another part of the flame, and so on until the power has been acquired of producing and preserving any required degree of softness.

Again, the effect should be observed of altering the strength of the blast of air. It will be found that the flame may be made at will either well-defined in outline, with the different zones clearly marked, or ill-defined and roaring, with no observable zones. The latter condition is well adapted for "annealing."

Glass is a bad conductor of heat, and consequently when exposed in a heated state to cold air, its surface becomes chilled while its interior is still hot. When cooling, glass contracts, and the result of a sudden chill is therefore to produce contraction of the exterior portion before the interior portion has commenced to contract. The further result is that one part of the glass is torn away from the remainder, and a crack is produced ; or if this does not happen, a state of tension ensues which renders the glass extremely brittle, and liable to break at some future time, when a slight blow or vibration upsets the equilibrium of the particles of the glass. An extreme instance of this state of tension is found in the toys called Prince Rupert's Drops (Fig. 26), which are little tears of rapidly cooled glass, formed by pouring the substance in a molten state into a cold solution of sal-ammoniac. If the tail of the drop is broken off, the drop, like the wonderful one-horse shay of Professor Oliver Wendell Holmes, gives way all over at once, and nothing remains but a heap of powder.

Glass, therefore, should always be heated slowly, and cooled slowly, so that the whole mass may expand and contract as nearly at the same rate as possible. The process of gradual cooling is called annealing, and the roaring ill-defined flame, which is a cool flame, is best adapted for the purpose. The hot air beyond the flame should also be utilised.

In the next and concluding article of this series, directions will be given for the performance of some of the most ordinary glass-blowing operations of the laboratory.

(To be continued.)

PRACTICAL SCENE-PAINTING FOR AMATEURS.

By HENRY L. BENWELL.

X.—PAINTING A LANDSCAPE—LAYING IN AND FINISHING.

ACTING on the instructions given in the last chapter, I will now suppose that the pupil has completed to his satisfaction the "laying out" and sketching of his picture. The next procedure is to colour it, and, on arriving at this stage of the work I must ask the practical reader to follow me throughout the present chapter as closely as he possibly can, for we have now arrived at the most important point in the art of scene-painting—namely, landscape-painting—which the novice will find harder by far than the painting of ordinary interiors. Indeed, the latter may often be executed by the ordinary house-decorator, but to paint exteriors, the workman must be, at least, something of an artist, and know how to put in a sky, paint foliage, get distances, and, above all things, obtain something approaching true perspective.

I do not intend to write one single line on the subject of landscape-painting, but what carries the greatest possible weight with it, and contains, as it were, therein, information absolutely necessary in this particular branch of the scenic art ; and, as I have bestowed a lot of labour and research on the preparation of the succeeding remarks, I ask—in justice to myself—for the reader's closest attention. If he deny me this, however, all I can say is that he will fail—ignominiously fail; for the subject is one that requires personal instruction in every detail to become proficient in this branch of the art. In fact, I may honestly admit that my resources are taxed to the utmost to give anything like adequate instruction in this series of papers, as I labour throughout under one great disadvantage, and that is, being unable to

call to my aid tbe use of coloured illustrations. With these few, but not uncalled-for remarks, we will proceed to work.

The sketching of the landscape having been completed in charcoal, the painter next takes a pot of burnt sienna and *strong* size, and picking up a "lining-fitcb" or "quil tool" goes carefully over the charcoal outline. This will show through all successive washes, unless they are very opaque, and when it is dry the canvas must be cleared of all surplus charcoal, for which purpose make use of the flogger (Fig. 24, see).

The colouring of the scene now commences. This may be accomplished in either two or three paintings, but the former being the quickest, and the method employed by the writer, bad best be adopted in the present case; and, for the purpose of illustrating the process, two drawings (Figs. 54, 55) have been prepared in sepia and ink, in order to get as near a coloured drawing as possible, although in the present instance, one is almost an absolute necessity.

Whilst referring to the drawings accompanying this chapter, I should like to point out my object in changing the subject of the picture in each example as far as possible, and not, as many would suppose, make use of one and the same subject in the last and present chapter. The reason is this: by varying the subject as I have done, I am able to give the reader a greater variety of designs or suggestions for scenes, whilst illustrating at tbe same time the particular method or process the "cut" is specially intended to elucidate, and which answers equally as well as if I had drawn tbe same subject in each successive sketch. Therefore, we will suppose in the present instance, that Fig. 54 is the subject laid out on our canvas, so let us set to work and attempt to put on the colour. To commence, have mixed in separate pots some raw and burnt sienna (both transparent colours). Refer to Fig. 54, and put in a grounding of raw sienna at A, A, A, A, etc.; viz., the tree in the centre, the church and cottages, the whole of the foliage and greensward on the left.

The Roadways, Water, etc.—As soon as this is dry take some burnt sienna and throw in as much shading as is shown at the identical points marked B, B, B, adding a few deeper shadows with a little vandyke brown. The "clotb" should now present the appearance of a sepia-painting in water colour, and the artist has also got a nice ground colour to work on; and, providing that the painter does not "lay in" his picture with colours too thickly mixed (which must never be the case) the sienna ground colour should show through all successive paintings and impart a warm and pleasing tone to the whole scene.

When the "cloth" is dry the sky may be laid in, for which purpose mix up the following colours in separate pots:—

1. Azure blue and whiting.
2. Whiting only.
3. Ochre, and whiting.
4. Damp lake.
5. Whiting, with the addition of a little orange chrome.

Mix these colours with half-and-half size; and having a two-tie and some pound brushes in readiness, and the palette and all pot colours by your side, commence with the azure blue (No. 1) at the top of your cloth, follow this down about 2 feet, then make a lighter tint with some whiting, next put in some of the fleecy clouds with a little ochre and damp lake, and nearing the horizon make use of a still lighter shade of blue, finishing off with a tint composed of one part damp lake to two of ochre. Next, as rapidly as possible, put in the darker shadows of clouds with a sash-tool, the grey tint for this is made by dipping the brush in the ultramarine, working it on the palette, and mixing with it, from their various compartments, and by the aid of the same brush, some white, Indian red and a little ochre and indigo. Work this well up with brush, and apply. Now put in the high lights of the clouds, using the white and orange chrome from No. 5 pot.

If the work has been properly done, it will, when dry, assume the necessary atmospheric effect which is obtained only by putting in all colours and shades whilst the whole is wet.

Before the cloth is dry proceed to lay in the distant foliage, C, C, C, with the darker shade of blue that has been used for the sky, also shade the church, cottages, etc., with the same colour where marked C. In laying in the sky, the painter must not mind the large tree in the centre, but work right over it, or, at least, as far as is necessary.

I need hardly say that putting in a sky such as the one just described, is the most difficult piece of work in the whole subject, and, as it has to be done quickly, the workman must have all he requires ready to hand, as there must be no stopping. Amongst other requirements is a bucket of clean water, wherein to frequently wash his brushes, or to thin out his colour when the size is too strong.

I should mention that the sky is laid in with the same brush as far as the blue is concerned, and without washing it; the other tints are first put in with a separate brush, and afterwards blended with the two-tie brush used for the blue.

For the cloud colours use a separate brush to each pot, and never dip more than a inch and a half of the brush into the colour, but take just enough to flow freely from the bristles. When the sky is dry the

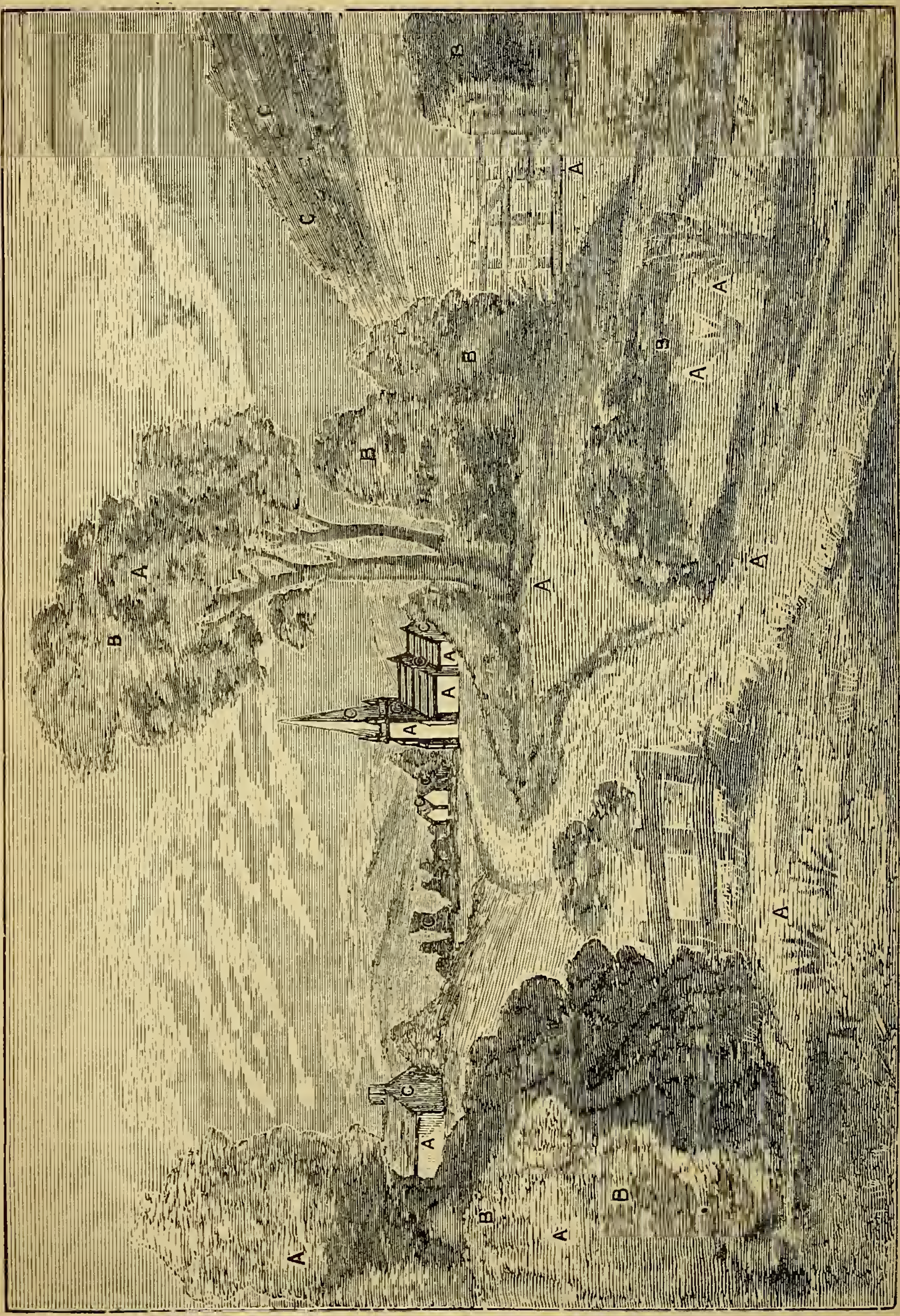


FIG. 54.—LANDSCAPE SCENE, SHOWING SKETCH IN CHARCOAL, AND FIRST PAINTING OR "LAYING-IN" IN COLOURS.

FIG. 55.—LANDSCAPE SCENE, SHOWING SECOND PAINTING, FINISHING, AND TOUCHING UP.

general laying in can go on, and the next part of the cloth that requires attention is the foreground.

If the tree in the centre has been rubbed out first lay in again with the siennas. Now, with the dark green lake put in all deep shadows in the foliage, and with a lighter shade of the same colour paint the greensward at the foot of tree in centre. Lay the water in with the blue used for the sky, and the foreground on the left of the sketch, with some yellow ochre. The road and footpath is laid in with rose-pink. Next, shade the foliage on the extreme right with a purple tint, and the grass underneath lay in with Dutch pink and a little green lake.

The general "laying in" is now completed, and the painter who arrives at this point of the work has accomplished a good day's work.

Second Painting.—We must now proceed to work up our scene and put the finishing touches to it. Firstly, then, put in the distant hills with a grey made by mixing some of the dark blue used for the sky with a little damp lake and yellow ochre. Now "mark up" the church and cottages, with a similar tint of a more decided tone. For the shadows use a little ultramarine and damp lake mixed up with whiting to the desired shade. For the roofs add rather more lake. For the distant foliage use the medium shade of sky-blue, and a very little Dutch pink. Pick out the whole of the grass with washes of green lake and Dutch pink, getting stronger as you approach the foreground.

The cottage on the left of sketch may now be marked up, using for the front, or lighted portion, ochre and flake white. For the shadows use a purple grey, use the same, and a little Venetian red for the roof, making the outlines somewhat defined. For the foliage near cottage use faint green, Dutch pink and grey cloud colour for shadow. Now work in the foliage in the foreground on the left. For shadows use a little indigo, and work up the lightest portions with Dutch pink, chrome, and raw sienna.

The trees and foliage in centre are painted next, and for these use green lakes, Dutch pink, and if the laying in with raw sienna has been well done, according to the effect it is desirable to get, it should look extremely well under the transparent greens and yellows. For deeper shadows use vandyke brown. For the trunks of trees rose pink and indigo may be used, or, if preferable, vandyke brown, using ochre and rose pink for the light, afterwards marked up with flake white.

I may here remark, that in foliage-painting every artist has his own particular nethod of compounding tints, and of putting them on the canvas. Those, however, who follow Birket Foster or William Beverley prove the most successful in this line.

The gate on right and railings on left next call for attention, these, however, are easily disposed of. Use vandyke brown as grounding, heighten the effect when dry, with orange red and flake white, in sharp and rugged markings, leaving a smudge of green here and there with a third brush. The trees on the right, above gate, require merely shading very slightly, with a deeper shade of purple, putting in stems and trunks with rose pink. The grassy slope here is finished with a little green lake and yellow chrome. The roads now receive a coating of rose pink merging into yellow ochre, as the foreground is reached. When this is nearly dry, mark up the ruts and footprints with orange chrome and Venetian red, using the cloud grey for the shadows thrown across the road. *Let everything increase in strength as the foreground is approached.* The foreground on left is marked up very boldly. Using first a wash of yellow ochre, put in the shadows with a glaze of vandyke brown, raw sienna and indigo. Next put in blades of coarse grass, and "heighten up" with sharp markings of flake white and chrome. Now, with solid colour put in a few loose stones, adding greyish shadows to them. Now comes the water, which glaze over with vandyke brown, very thin; now with a clean brush put in some of the darkest sky-blue and blend and soften this into the brown; next with a clean brush take a lighter shade of blue, and blend this into the other; finish off towards the foreground with flake-white. *Lay these colours in thin* so that the sienna ground may show through, and thereby impart a tone to the whole. Leave this to dry, and then deepen the shadows with another glazing of vandyke brown, and whilst wet, put in the reflections of reeds and rushes in the water. For this, mix raw sienna and green lake to obtain an olive grey or "greyish olive" tone, and deepen with Indian red. Deepen the water near the shadowed parts with a little Prussian blue, putting in here and there a few streaks of rose pink or orange chrome.

The artist should now retire to a considerable distance, and see what effect he has realized on this part of the cloth. It will, probably, require a lot more work to look at all like water from the auditorium, if so, it is the painter's fault, not mine; he has, no doubt, softened off too much, and must go over his work again, and paint more boldly, leaving distance to do the rest.

Touching Up.—The painting ought by this time to have a presentable appearance, but it may possibly be necessary to heighten the effect in some parts of the work; for instance, suppose the cottage on the left requires to be brought a little nearer, put in a little darker shade of the colour required, and mark up the outlines more boldly, when the desired effect

should be obtained. Again, the church, etc., may (and it is very likely to be the case) not look so far off as the artist intended it should. In this case "thin colouring" must be resorted to, so as to give it a hazy kind of appearance. Thin colouring is done like this: find the colour used in the last painting of this particular portion of our cloth, and add a little whiting thereto; next, thin out the colour with some working size and a little water. Dip a pound brush in the colour so prepared, and pass it lightly and rapidly over the painting at the desired spot. Have the brush as full as possible without danger of running, and *do not go over any part twice.* When the cloth is again dry the distance wished for should have been obtained. Thin colouring requires a *deal of practice*, and, unless the amateur be very careful the whole picture will be spoilt. It is hardly possible, however, to put it on too thin.

Other parts of the picture may be made to look more effective with a few dexterous touches of the brush, and the use of a little flake white. The foliage may be "cut up" a little more, and a few sharp markings put in the grass and rushes. Also with the white put in a few streaks of light on the water, and touch up the lighted parts of the gate and rails.

I have now brought the painting of a scene to conclusion, and I trust those of my readers who may attempt to paint the simple example here given—which, by the bye, is given for its simplicity and not as a work of art—may feel as much pleasure in their work as I do in my own share; this honest but feeble attempt to instruct them in an art I love so well.

I purpose concluding the present chapter with a few general remarks on landscape-painting, which the student will please carefully study. Firstly, then remember that every object introduced into a scene must be painted very bold indeed; no softening off to any great degree is required, the distance that the scene is situated from the audience does all softening and blending. When I say the scene must be painted boldly, I do not by any means infer that it may be done carelessly; on the other hand, let everything be in proportion, a little exaggeration in outline, gradation, and colour cannot be helped, it is necessary for the peculiar kind of work scene-painting is; for in this art to produce an effective picture as viewed from a distance, the artist must make use of bold and vigorous work, which to those standing near may look like a series of splashes and daubs, but viewed from the auditorium we have a picture pleasing to the eye and effective in drawing, colour and shade. The scene-painter paints for the audience, and those alone must he consider when at work.

Oil-painters of long standing have been known to attempt distemper painting with utterly disastrous results, probably because they will not sacrifice minuteness in detail, and paint altogether too finely and with too great perfection and delicacy. The artist must sacrifice all this in scene-painting, and much more besides. Most artists know, of course, that distemper colours are several shades darker when wet, and it is generally known that they dry back to the original tint, the tint possessed in the powdered state before being mixed; but it is not generally known that the addition of size makes each colour several shades darker than it is when simply in a powdered state. It is the knowledge of this fact and the thorough understanding of the effect the tints will produce on the cloth after drying, which go far to constitute one of the great secrets of the art. Different painters, however, have different methods, and there is as much variety in the schools of scene-painting as in other branches of art. The French, German, and American painters use opaque washes. The English school make use of thin glazes, and it is here that the greatest advances have been made. This, in scene-painting, is the quickest and most effective method. I think I have now said sufficient to prove that there is no branch of art where greater care, knowledge, and ability is requisite, than in scene-painting.

(*To be continued.*)

ETCHING ON COPPER.

By FRANK CHASEMORE.

II.—THE PRINTING PRESS—ITS CONSTRUCTION—TAKING PROOFS.

OUR copper plate being now ready for printing, I will in this paper describe my press and how I made it.

The press for plate work is quite different in construction from the ordinary type press. It consists of a frame or bed, on which is a carrier, supporting an iron slab, on which the inked plate is placed, and covered with damp paper; this in turn is covered with two or three blankets. Over this slab is a steel roller working in adjustable bearings, and turned by means of a cross-lever handle. The iron slab bearing the plates and blankets is forced under the roller, and, the handle being turned, the plate passes under it and comes out on the other side. The blankets are then removed, and the printed proof lifted from the plate, which is then inked ready for the next impression.

Presses can be made of any size to suit the owner, but, of course, a large plate cannot be printed in a small press, so I thought it advisable to make one

that would be large enough to print any plate I should be likely to etch. Fig. 10 is a perspective view of it. The wooden bed, or top of table, is 24 inches long by 18 inches wide, and is 3 inches thick. It is made out of a slab of beech, which I think is the best wood for the purpose, being both hard and tough, and not so likely to split and warp as oak, but the same dimensions would do if oak were used. The upper surface is planed quite level and true. Fig. 11 is a plan of the upper surface. Near each of the longest edges, two holes, $\frac{1}{2}$ inch in diameter, are bored right through the wood. These holes are bored one on each side of the middle line joining the two opposite edges, and the centres are 2 inches apart, and $\frac{3}{4}$ inch from the edges of the bed. Within these holes a strip of iron is screwed firmly to the bed on each edge, just missing the holes. These iron strips are $\frac{1}{2}$ inch wide and $\frac{1}{4}$ inch thick, and are fastened by seven screws, the heads being well countersunk and filed off flush with the upper surface. These strips are perfectly parallel to each other, and are used as guides to the carrier.

The bed, or slab, is mounted on four legs of wood, in pairs, halved into each other crosswise; the legs are mortised into the beds. The lower ends or feet are screwed to the floor by iron angle pieces, to keep the press firm whilst in use. The legs are three inches square. Fig. 12 represents the carrier, on which the iron plate rolls smoothly under the large roller.

The side-pieces are iron rods $\frac{3}{8}$ inch to $\frac{1}{4}$ inch, with the narrow edge up. They are 18 inches long. In each, through the middle line, are bored six holes $\frac{3}{16}$ inch in diameter. They are connected into a frame by two rods $\frac{1}{4}$ inch in diameter, having a pin and shoulder cut at each end $\frac{1}{2}$ inch long and $\frac{3}{16}$ inch in diameter, holes in each side-piece being bored

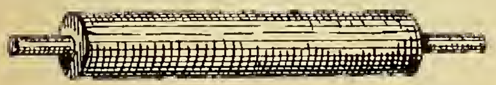


FIG. 13.—LARGE STEEL ROLLER FOR PRESS.

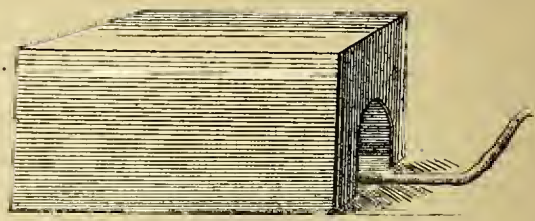


FIG. 17.—PLATE WARMER.

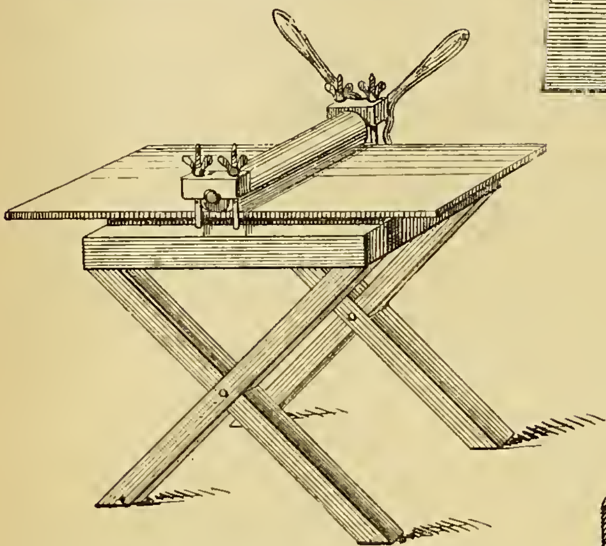


FIG. 10.—PERSPECTIVE VIEW OF PRINTING PRESS.

FIG. 11.—PLAN OF UPPER SURFACE OF PRESS.

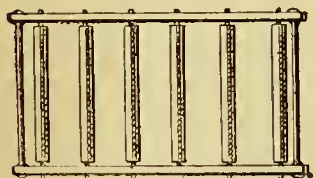


FIG. 12.—CARRIER ON WHICH IRON PLATE OF PRESS ROLLS.

FIG. 16.—DABBER OF CLOTH AND CANVAS.

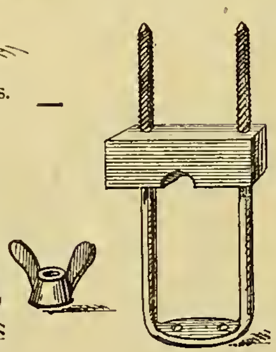


FIG. 15.—IRON RODS, BEARINGS, AND FLY NUT.

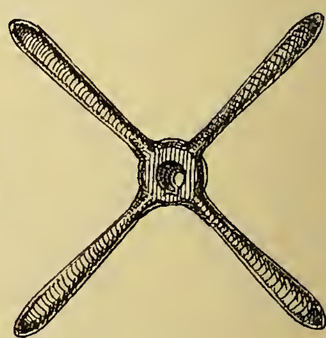


FIG. 14.—IRON CROSS HANDLE FOR TURNING ROLLER.

$\frac{1}{2}$ inch from end, $\frac{1}{16}$ in. in diameter. These rods are riveted to the side-pieces to make all firm and square.

Before connecting the sides, six iron rollers are placed in the six holes, so that they turn freely. These rollers are turned up in the lathe, and are $\frac{3}{4}$ inch in diameter, having a pin turned at each end $\frac{1}{4}$ inch long. The rollers themselves are $14\frac{3}{4}$ inches long, including the pins. This frame requires great care in putting together, as, unless quite square and the rollers working true, the iron plate will work to one side.

FIG. 18. INKING THE PLATE.

Fig. 13 is the large steel roller. This must be turned up in the lathe, and the sides made exactly parallel. It is 3 inches in diameter in the thickest part, which is 15 inches long. At each end a shoulder is turned $\frac{1}{4}$ inch long, and 2 inches in diameter; the pinions are 1 inch in diameter, and one is $1\frac{3}{4}$ inch long, and the other 3 inches. One side of the longer one is filed down to about three-eighths of an inch in width to keep it to the cross-handle by. This roller is polished smooth in the lathe.

Fig. 14 represents the cross-handle, having a centre hole bored through 1 inch in diameter to fit the pinion on the roller. It is made of iron. The joints where the arms are welded to the boss must be made very strong. Any blacksmith can make this. The arms are 10 in. long, and 1 inch thick at the stoutest part; the boss is $2\frac{1}{2}$ inches in diameter, and $1\frac{1}{2}$ inch thick. A slot is cut to the centre hole $\frac{1}{4}$ inch deep and the same in width.

The long pinion of the roller is forced into the centre hole of the boss, with the filed side corresponding with the slot in the hole, and keyed to the handle with a piece of iron bar $\frac{1}{4}$ inch square driven tightly into the slot. The roller is connected to the bed by two bearings working on iron rods, with nuts to regulate the distance of the roller from the bed. Fig. 15 represents one of these bearings. The iron rods are 9 inches long each and $\frac{1}{2}$ inch in diameter. I made these out of a rod 20 inches long, and bent into the form of a staple, so that the rods were 2 inches apart from centre to centre. The iron at the bend is flattened out till it is about 1 inch wide, and two holes drilled through it. Each rod has a thread cut on it about half its length, and is fitted with a butterfly nut, as shown to the left of the rods and bearing in Fig. 15. The bearing is made out of gun-metal $3\frac{1}{2}$ inches long and $1\frac{1}{2}$ inch square. A semicircular bearing hole is cut in the under side 1 inch in diameter, and two holes drilled from top to bottom $\frac{1}{2}$ inch in diameter, and 2 inches apart from centre to centre.

These screw-bars are passed up through the holes in the wooden bed, and fastened by two screws through the holes in the flattened portions. The gun-metal bearings are then put on, and the nuts screwed down. Fig. 10 shows them in place. The iron plate is $15\frac{1}{2}$ inches

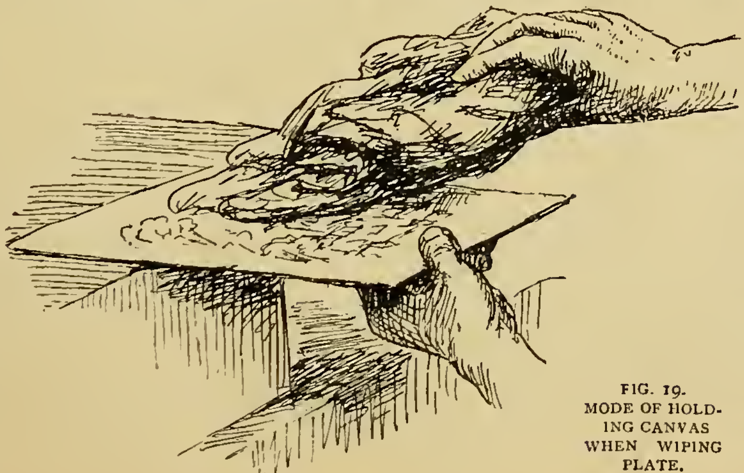


FIG. 19. MODE OF HOLDING CANVAS WHEN WIPING PLATE.

wide, 34 inches long, and $\frac{1}{4}$ inch thick. This must be quite flat, and have the surfaces as smooth as possible. The press is put together in the following manner: The carrier is placed between the guides on the bed, and the iron plate placed on it resting on the rollers. The large roller is placed on the iron plate, and the bearings screwed down till the pinions fit into the holes cut for them.

Such is my press. I will now describe the operation of taking a proof. The printer will require two or three more articles before setting to work. First of all, a bench in front of a window, a stone slab for the ink, a large pad or two (shown in Fig. 16). These dabbers are made of cloth, and covered with printer's canvas. They are about 6 inches high and 5 inches wide.

Fig. 17 is a plate warmer. This is made of strong sheet iron, and stands 8 inches high, and is 18 inches by 12 inches. The top is smooth. One end is cut away to allow the lamp to be put in. This is an argand gas burner. The heat should be such that the hand can be placed on the plate without inconvenience. A stock of printing paper is required, and must be kept damped on a side bench. The paper must be thoroughly wetted, but must be wiped with a clean sponge before printing to remove the surface water. The blankets can be bought at the shops where etching materials are sold. Black and brown copper-plate inks can be bought at the same shop, and I should not advise making ink at home, as it is a very dirty and tedious process. This, with some printer's canvas, will be all that is wanted for taking a proof.

Take the plate and thoroughly clean it with turpentine, and place it face upwards on the warmer, and get the dabber well charged with ink. The plate is then removed from the warmer and placed on a block of wood. The printer then proceeds to cover it well with the ink, giving the dabber a rocking motion to get the ink into every line. Experience only will teach the printer to judge when the plate is sufficiently inked. The dabber is then laid aside. Fig. 18 shows the printer at work inking a plate. The superfluous ink is next wiped off with canvas, and afterwards with the hand if a dry proof is required, but if not, the plate is wiped till a very thin film of ink only is left on it. The printer then takes a roll or bundle lightly done up in his right hand, and holding the plate in his left, draws the canvas lightly all over the plate from top to bottom, giving the canvas a small flapping motion. The manner of holding the canvas is shown in Fig. 19. This slightly pumps up the ink from the lines, and adds to the softness of the impression.

The iron plate of the press is now run nearly out and the plate placed on it face upwards, with a sheet of paper under it. The printer next takes a sheet of damp paper and places it carefully over the plate. The blankets being put over the paper, the handle of the press is turned and the plate passed under the roller. A considerable pressure is required on the plate, as the paper has to be forced into the lines in the copper plate. The blankets are now removed, and the proof taken off the plate. If the edges of the plate were not quite clean, marks will be made in the proof.

India proofs are printed on India paper. The plate is inked, cleaned, and placed on the iron plate; on this is placed a sheet of India paper, and the damped paper placed on that. The blankets are put on, and the whole passed under the roller. The pressure causes the India paper to adhere closely and permanently to the damp paper, and adds to the effect of the etching. Etchings look very well if printed in brown ink; indeed, I think that they are considerably improved. After the proof is taken, the plate must be carefully cleaned with turpentine, as dry ink, if any is left on the plate, is very difficult to remove.

BOAT BUILDING WITH WILLESDEN WATERPROOF PAPER.

By R. C. C.

MY double canoe, built of four ply Willesden Waterproof Roofing Card, or "Paper," is a success; she paddles more lightly, and sails better than another canoe I built of pine on the same lines.

The average pace of my new canoe when loaded with tent, rugs, and all camping requisites, which completely fill every decked part of the boat, is, with two paddling, six miles an hour with the stream, and four against it; this, for a canoe with 30 inches beam, I consider fast.

Since launching her I have been for two camping trips in her, each of about a week's duration, the first of which, to Henley Regatta, was a good test of what she could stand without injury, particularly coming through the locks the day after the regatta.

With regard to the appearance of the canoe, I am told she looks particularly well, the contrast between the dark olive green of the varnished "paper" and the mahogany top streak and deck, being much admired.

I doubt if the way in which I divided my canoe at midships, could be easily or satisfactorily applied to any canoe except a double one, without the top part

of the flanges being too much in the way of the crew; but in a double canoe, as the backboard of bow rests on a bar at midships, the top of the flanges instead of being in the way becomes useful for bow's backboard to rest against. I built my paper canoe as follows :—

I cut the keel in *one* piece or length, fixed bow and stern-posts, and the four or five wooden sections on the keel in the usual manner. except that instead of a section at midships, I fastened the wooden flanges there, which I made by first cutting an exact pattern in paper, which was a flattened half circle in shape ; this I took to Messrs. Hopton and Sons, 67 *George Street*, *Euston Road*, *N.W.*, bent timber merchants, and gave them instructions to bend me some strips of $\frac{3}{4}$ inch ash, 2 inches wide, to the pattern I gave them, which they had little difficulty in doing. I then cut two pieces of $\frac{3}{4}$ inch oak to arch over and join the ends of the two semicircles of bent ash together. These two pieces of oak were cut to scarf into the ends of the ash, and cut slightly curved for about 5 inches from each end for the side decks to rest upon, with a step up of about $1\frac{1}{2}$ inches, for the coamings to be screwed against, and the top flat, to allow the folding decks to slide over. I then clamped the two wooden semicircles together, and drilled ten holes right through both pieces, where I thought it most convenient to place the $\frac{1}{2}$ inch bolts. I then bolted it together and cut a slot at the bottom, through both pieces, to fit tightly over the upper part of the keel. and also in the same way cut out the slots for the stringers to be fastened into. I then unbolted the flanges, and on the inside of one (between the bolt holes and the inside of the shell of the canoe), I cut a shallow groove all round, except for about a foot at the top of the deck, for the purpose of fixing in some $\frac{1}{4}$ inch round india-rubber (at 3d. per foot), to form the water-tight joint, making the groove wide enough to allow the rubber to expand when the flanges were bolted together. I then bolted the two flanges together, and screwed them both down to the keel, with two screws only through each flange, and then fastened them firmly in place, with the stringers running right round the canoe from stem to stern, beginning with the stringer to which the deck was to be nailed or screwed. All the stringers, with the two wooden streaks, each side of the keel (to prevent it warping) and the "paper," all finished at, and were fastened on to, these flanges—that is to say, the boat was built in two parts, except for the solid keel and the bolts in the flanges.

Great care is required to get the whole shell of the canoe quite water-tight, particularly where it is divided at midships.

Having got so far, I turned the canoe keel upwards, and after removing the bolts I cut through the keel by wedging open the flanges and inserting a bow saw, without the bow and one handle, then fastened on the handle, and with the assistance of someone below carefully cut through the keel, and the canoe was in two parts. The india-rubber was then fastened in with bicycle rubber cement, and the inner parts of the flanges well painted.

These flanges proved a perfect success, being quite water-tight, and making the canoe stronger than it would have been without them.

PRACTICAL LESSONS IN WOOD CARVING.

By E. ARTHUR EDWARDS.

VIII.—HANGING WALL CABINET (*continued*)—DOORS—POLISHING.

AS our labours in connection with the cabinet approach completion, and the difficulties in the details of construction are mastered one by one, a sanguine, self-confident feeling steals over us, and a vision of £ s. d.—perhaps only "d." after all—or its equivalent in *kudos*, arises out of the chips, quickly allaying what latent fears we may have harboured as to any tangible success achieved : for there can be no doubt that good carving, combining artistic workmanship with utility, obtains ready sale and often fancy prices at the Art or Industrial Exhibitions happily now so frequent, so here is a wrinkle for those who fail to find a recipient for their last and choicest bit of "What's that? Pie-crust?"

It is to be hoped that the several portions of the cabinet hitherto described, and now ready for putting together, will have produced such a state of mind in the executant that he feels his whole reputation depends upon the thoroughly artistic finish of the cupboard doors, now alone remaining.

The mirrors, of course, form an attractive feature in the *tout ensemble ;* and the pains expended upon the fretwork and carving elsewhere will doubtless bear fruit upon a close examination ; still, their beauty is to some extent hidden by the books or ornaments adorning the shelves : whilst the doors, on the other hand, stand out so prominently that special and untiring efforts are necessary to satisfy one's critics, and it will be recognized here more than ever that a firm grasp of the "Try, Try Again" theory is most essential. Several rough trials may be necessary, in fact, before the bramble can be distinguished from a horse-chestnut leaf, and one's early hops are apt to be mistaken for potatoes suffering from kidney disease ; these little accidents, however, will soon be avoided, and, if they teach a lesson in perseverance, will serve a purpose after all.

It will be observed that the doors are framed panels, and for those who do not feel competent to make a neat job of the framing, I recommend two panels, each $5\frac{3}{4}$ inches by $5\frac{1}{2}$ inches, marked with the veiner in imitation of the frame. The alternative is much the more workmanlike plan, and I here give a section (Fig. 24) showing rebate in which to fit the panel: the vertical sides are $5\frac{3}{4}$ inches long, and the horizontal $5\frac{1}{2}$ in. by $\frac{1}{4}$ inch thick. The panels are each $4\frac{1}{2}$ inches by 4 inches by $\frac{1}{2}$ inch thick. They are hinged on to the corners, and a small lock may be fitted with good effect: hinges, lock escutcheon, and bolt (for inside) may be obtained of H. Zilles, 14, *South Street, E.C.*, full particulars of which are given in his list, No. 22.

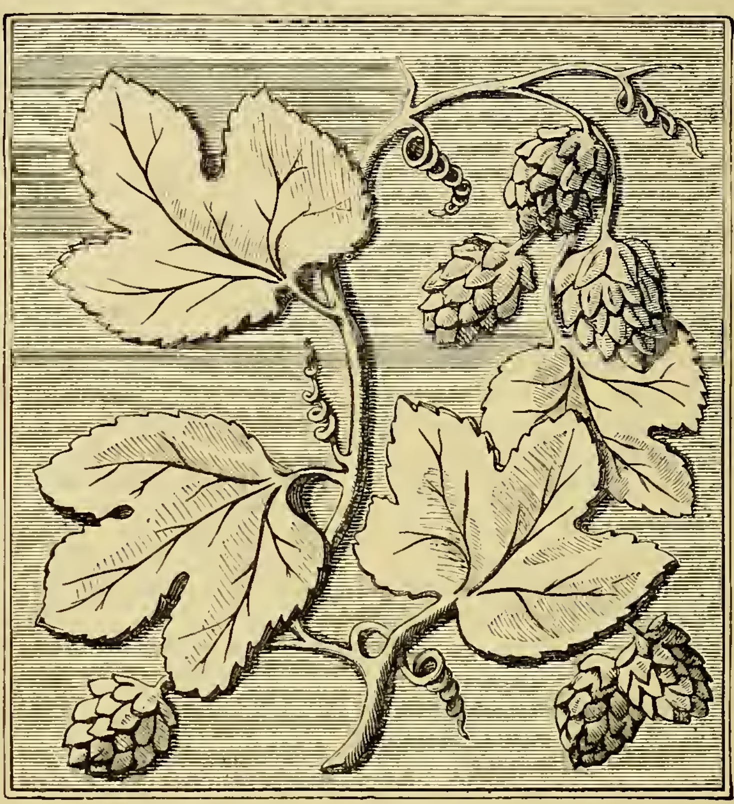


FIG. 25.—LEFT HAND PANEL OF CUPBOARD.—THE HOP.

The groundwork of the panels should be cut away to the extreme edge, so that they fit close up to the frame, under which the stamping may be carried. The thickness of the wood will allow the pattern to be carved in deep relief, and every advantage should be taken of

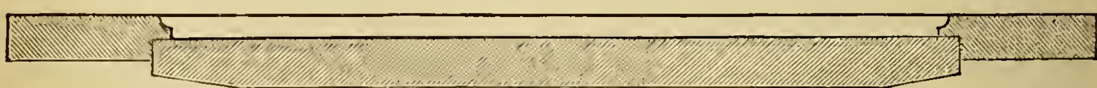


FIG. 24.—SECTION SHOWING REBATE IN FRAME FOR RECEPTION OF PANEL.

this, as the effect will be much heightened thereby: the undercutting will, of course, have to be thoroughly well done, and the stalks may in some places be *completely* rounded off to the extent even of admitting daylight beneath them: the upper surface being left almost intact, sufficient space will be given to attain this effect, say for $\frac{1}{2}$ inch here and there. Some little difficulty may be found in producing satisfactory thorns (Fig. 26), but with a good hard piece of wood, and with an example in front of one, let us hope this may be overcome. The blackberries are very similar in form to those of the ivy already done, and will be found tolerably easy—as also the leaves—for they are nearly flat, and merely require very neat veining and well-cut margins. The same remarks apply to the hop leaves (Fig. 25), as, though they differ in external form, they will be found very satisfactory studies after a few trials: the tendrils look worse than they really are, and if done in one block and afterwards divided, will be considered mere child's-play. This brings us to the end of the actual carving, and with a few words on the polishing and general finish I shall reach the end of my tether for the present. It is purely a matter of taste whether the cabinet is stained, polished, or merely oiled and rubbed: either method would do very well for certain woods, and I should be guided chiefly by my choice of wood in determining the style of finish.

Oak is always spoilt, in my opinion, by staining, and in many cases by polishing, and I much prefer simply to oil it so as to bring out the grain well, and then get what little dull-polish is attainable by hard rubbing: sometimes, I merely rub with beeswax on a very hard nail brush, and in such a case as this, I should give variety by introducing both methods—say beeswax for the cupboard doors, and oil-polish for

the remainder, giving a few extra coats to the door-frames to emphasize the contrast. Pear-tree, again, would perhaps look best "ebonised" as it is termed, or, in other words, stained black, and dull-polished, with a little gold-beading here and there to lighten it up, for instance, just under all the turned knobs, in the rim enclosing the veined rush pattern at the top, the spokes of the fluting, and the bevel of the door-frames. Or, should walnut be selected, it might be French-polished; the flat parts, such as the door-frames, and the veined rushes, being left dull for a little variety. Then again, in a job of this sort, two or three kinds of wood may be used with advantage, the best grain being reserved for the doors, such as olive or bass wood, and the method best suited to bring out their characteristic must be adopted in finishing.

These remarks may serve to show what can be done to the cabinet especially in working on a larger scale than that given here, and may also have a general signification as showing how numerous and varied are the methods of finishing off carving of all sorts. In conclusion, I must express a hope that my "Practical Lessons" may have been instrumental in familiarizing some few aspiring artists with the rudiments of wood carving, in the sure conviction that

FIG. 26.—RIGHT HAND PANEL OF CUPBOARD, WITH FRAME SURROUNDING PANEL.—THE BLACKBERRY.

many pleasant and profitable hours may be spent in the pursuit of so fascinating a branch of art work: and at some future time, I will gladly enlarge upon the subject in its more advanced stages, provided sufficient interest is taken therein by my fellow amateur workers.

AN ORNAMENTAL SHELF FOR TURNERS.

By ALEXANDER MARTIN.

(*For Illustrations, see Folding Sheet issued with this Part.*)

AMONG all the various useful and ornamental articles produced by means of the turning-lathe, I am sure the wall-shelf, illustrated in our Folding Supplement this month, will hold no mean place. It has the look of being a regular cabinet-maker's job, although there is only one piece in the whole thing which cannot be made in the lathe, viz., the backboard. Everything else is turned, and there is no intricate work about it either, all plain turning, as we shall see as we proceed. I mention this because many amateurs, I am sure, will, on looking at the illustrations, immediately say, "All very good, but I could not manage to make that. I might be able to do the turning, but to make up such an article is quite beyond my power." Not so, my friends; for, as I have already stated, everything is turned except the backboard; and, provided all is properly done, no trouble whatever need be expected in putting the whole job together.

Now, to start with, what wood shall we make it of? Almost any wood would be quite suitable, provided it is not too soft. Cherry, ash, walnut or mahogany would, I think, be especially suitable; the last-named wood is what I would myself prefer.

Before giving a list of the different pieces required, it may be as well to say that Fig. 1 is the front view of the shelf when finished. Fig. 2 is a section up through the centre of the front view. Fig. 3 is the side view, complete. Fig. 4 is the back view. Fig. 5 is the view looking from underneath. Fig. 6 is a plan of the shelf. Fig. 7 is the view looking from above. These are all drawn to a scale of 3 inches to the foot, or one-fourth real size. Figs. 8 to 11 are all drawn full size, and will be referred to as we proceed.

The following is a list of pieces of wood required for the shelf as shown :—

1. Two pieces $8\frac{1}{2}$ by 6 by $4\frac{1}{4}$ inches; 2. Two $8\frac{3}{4}$ by $6\frac{3}{4}$ by $4\frac{3}{8}$; 3. Five $2\frac{1}{4}$ by 1 by 1; 4. Two $2\frac{1}{4}$ by 1 by $\frac{1}{2}$; 5. Two 11 by 1 by $\frac{1}{2}$; 6. Two 6 by 6 by $\frac{1}{2}$; 7. One $15\frac{1}{2}$ by $7\frac{1}{2}$ by $\frac{1}{4}$.

These sizes are *all finished sizes*, so in getting out the different pieces, allowance must be made for working; everyone will know best himself how much wood he would like to come and go upon. No. 1, in the list above, is for the shelf and all the turning underneath it, excepting the quarter circle pieces which are put on afterwards. Fig. 11 shows a section of the edge of the shelf, underneath which the quarter circles are placed. You will notice that *two* pieces of No. 1 are required. One piece, $8\frac{1}{2}$ by 6 by $8\frac{1}{2}$ inches would do as well, at any rate, for the turning; but, after being turned, it would need to be sawn exactly up the centre. Now, the simpler plan is to get two pieces the size I have named in the wood list, having two of their sides evenly dressed, and glue them together with a layer of thin brown paper between them. When the glue has had sufficient time to set, put them in the lathe in such a position that the joint will be exactly in the centre of the piece when turned.

After the turning is finished the insertion of a chisel will easily split the piece into two clean halves; the brown paper adhering partly to one and partly to the other. A little warm water will soon remove the paper, and also any glue that may be there. One of these pieces only, of course, is required; the other may be laid aside, and may do for another shelf if you feel inclined to make a companion to this one. If expensive wood is being used, one of these two pieces may be of pine, which will be a decided saving in the cost of the wood. No. 2 in the wood list is for the cornice and all above it, excepting the little knobs round the edge, which are put on afterwards. Fig. 9 shows the detail of the cornice moulding—full size—above which the turned knobs are placed. The fringe is shown in its position, nailed to the lower member of the cornice. Two pieces are also required of this (No. 2), for the same reason as for No. 1, and all remarks about that fact concerning No. 1 hold good with No. 2. No. 3 on the wood list is for the little turned knobs on the edge of the cornice. Five complete knobs are required, turned as shown above, in Fig. 9. This is drawn full size, and notice the pin turned at the foot, to fix them to the cornice. No. 4 is for the two half knobs, one at either side, next the wall. (See Fig. 7, which is a view looking down on the cornice.) These two pieces must be glued together as before described, turned, and then split up again. No. 5 is for the two half pillars, one on either side, standing between the shelf and the cornice; they must also be glued, turned, and split up again. Fig. 8, drawn full size, shows the members of the upper half of the pillar, the under half being exactly the same, but having $1\frac{1}{4}$ inches of a plain surface at the foot. (See Fig. 1.) No. 6 is for the quarter circles underneath the shelf. Two rings 6 inches outside diameter, $4\frac{5}{8}$ inches inside diameter, and $\frac{1}{2}$ inch thick, must be turned, and a bead put on the outside edge. Fig. 10 shows a section of

this ring. Each ring must now be cut into four, giving eight quarter circles—one more than you require.

All the turning is now completed, and the next thing is to get the back ready. No. 7 in the wood list is for it; and it must be cut as shown in Fig. 4 by the lines outside the circles which represent screws. 15½ inches is the extreme size from top to bottom.

Now for putting all our separate pieces together. The cornice and shelf must be checked out on the back to receive the backboard. To do this, lay the backboard in the position it will occupy on the back of the cornice, and draw a pencil line along the edge, marking on the cornice where it is to be checked out. Do the same with the back of the shelf; and then proceed to check out the space required to the depth of ¼ inch—the thickness of the back. This does not require to be neatly done, as it is never seen after the shelf is up; but care must be taken not to injure the faces of the different pieces. Next get the little knobs put in. Divide the space from edge to edge, all round equally; and bore with a brace and ⅜ bit a hole for each, making the hole deeper than the length of the pin that is to go into it, in order to allow the shoulder to come right down on the cornice. To get the end ones bored you will need to put the centre of the bit in a little from the edge; but you can put a little chip in the hole again to keep the back of the half knob exactly flush with the back of the backboard; this is a thing which must be attended to. See that they all go nicely into their places, but do not glue them yet.

The quarter circles underneath the shelf next demand notice. A little pin must be put into one end of each quarter circle and into the shelf, as shown in Fig. 2. This is rather a nice operation, but with care can be easily managed. Fix the quarter circle in the "bench lug," and bore a hole quite perpendicular to the surface, about $\frac{3}{16}$ inch in diameter would do nicely, and ⅜ inch deep. Have a number of little round pins ready about half an inch long and thick enough to go nicely into the hole just made. Underneath the moulding on the shelf edge, measure the position for the hole that this pin must go into and bore it. Fig. 11 shows a section of the shelf edge with the hole bored in it ready for the pin. The other end of the quarter circle (A, see Fig. 2) rests on the list formed in the turning; and when all the quarter circles are placed in position, it will be found that they lie close to each other, so that when all is ready to fix up, a little glue will secure them in their places. The two quarter circles next the wall must, with the plane, be reduced in thickness to one-half of the others, which will be ¼ inch. Now take all these quarter circles out of their places, marking them 1, 2, 3, 4, 5, 6, 7, and their places with corresponding marks. Pencils marks will not do, for in polishing these would be destroyed. They must be marked with a chisel—say one ⅛ inch broad, and marked where the mark will not be seen when they are put on again.

The polishing is the next thing to look after. If the amateur is not well acquainted with polishing, he should send it to a practical polisher; for it would be a great pity to spoil this nice job in the finishing of it. Take all the separate pieces to him, for he will make a very much nicer job that way than if you took it all fixed up. See that you get them *all* back again, and then comes the fitting up and fixing all together. Take the backboard, put the half pillars which stand between the shelf and the cornice in their places, and screw them from the back with ½ inch screws, countersinking their heads, of course, to have the back all flush. *All* the screws put through the back should be countersunk. It would be as well, too, in fixing these half pillars, to watch that you put the screws into the thickest part of the turning. Two little wall-plates of brass are needed—they cost one penny per pair—to hang the whole thing up when finished; they may as well be put on now, as shown at B, Figs. 1 and 4. Screw them on the back of the backboard, ½ inch screws being large enough; they will go into the pillars a little way, but so much the better. Glue in the little knobs on the cornice, and the quarter circles underneath the shelf. At any part where glue is required, as, for instance, at the joining of the lower end of these quarter circles and the turning, the polish must be carefully scraped off before applying the glue, else the glue won't hold. Screw the backboard to the cornice and shelf, propping these in their position until they are quite secure.

It will be noticed that I have shown a fringe on the cornice. Although this is not necessary, it will decidedly enhance the appearance of the article. Any ordinary draper's stock does not contain the proper kind of fringe. It should be of a heavy nature, mostly wool, with, perhaps, a little silk in it; but any upholsterer's furnisher will be able at once to give you the proper thing on your acquainting him with the purpose for which you wish it. Twelve inches is the exact length of fringe required, and it is fastened to the cornice with little gimp pins, or ornamental brass-headed studs. It might also be an improvement if the face of the backboard were covered with cloth of some sort; frieze or some material of that kind would do very well, and would not show signs of old age so soon as plush or velvet would. The colour is the most important thing in connection with this. If the wood selected is mahogany, a crimson or rich orange colour would do; if walnut, a russet green would look well, or a rich warm brown; and if the wood is of a light tone, something in the way of yellow or buff would be best. These things must always be

left to individual taste, so no hard and fast rule can be laid down, except this, that if you decide to cover the backboard see that the fringe you get matches the colour you select. It does not need to be *exactly* the same shade, but to have some of the colours of the fringe, as most probably there will be several in it—I say, have some of the colours somewhat of the same shade as the material you use. One piece of this material 11 inches long, by 5½ inches broad is what will be required; and it should be carefully nailed with gimp pins all round its edges, say at distances of ½ inch, not more. There is no use of fitting it to the shape of the turned pillars at the sides, for it is quite unnecessary, and I have made no allowance in the size of cloth I have given for such shaping.

And now, the only thing that remains to be done is to select a suitable position on our walls to honour with our handiwork, where it may appear in all its splendour as "a thing of beauty" and "a joy for ever" to the cultivated eye of the art critic, as well as to the inquisitive gaze of the journeyman ; and it will be sure to receive the admiration of the household.

A SIMPLE WOODEN LATHE.

By J. L. DWYER.

I HAVE just completed a lathe I have made for my brother, a rising young amateur; and as many of us, perhaps, will wish to perform the same kind office for friend or relative, or make one for one's own use, I am induced to offer a description thereof.

The fixed headstock is a block of ash, 11 inches long, 5 inches wide, and 3 inches thick, of the form shown in Figs. 1 and 2. My brother is ambitious, so I made the lathe 7 inches centre. Fig. 3 shows a disc of metal, cast iron, about ⅜ inch thick, but better if ½ inch or ⅝ inch thick. Screw holes are bored as shown, and a conical hole, A, turned out in the lathe.

Fig. 4 shows the mandrel, B being a movable ferrule, made of a piece of a gun barrel about an inch long and $\frac{3}{16}$ inch thick. The point of the ferrule is coned down as shown, to fit the conical hole in Fig. 3. The body of the mandrel is 5 inches long and ¾ inch thick to fit the ferrule very tightly. The nose is 1 inch long ⅞ inch thick, and the collar 1½ inch in diameter and ¼ inch wide.

I made a centre in the tail end of the mandrel more than a quarter of an inch in diameter, and turned it in my lathe on this centre. I also turned the ferrule and pulley on the mandrel, so that when finished everything was true. I hardened the tail of mandrel and ferrule by heating them to a bright red, and twisting them about in a mixture of prussiate of potash and sal ammoniac until they were pretty nearly cold, then heating them up again and plunging into cold water, they came out as hard as flint.

The tail-pin, Fig. 5, is a ⅝ inch screw of steel, screwed through the middle of a piece of horse-shoe iron, a couple or three inches long. A lock nut prevents it from shaking loose. The pulley is made of hard wood. The large wheel, 8½ inches in diameter, is for stopping and starting the lathe, or for heavy work, the smaller ones, 3 inches and 3½ inches, being used for ordinary turning. The pulley is 2½ inches thick, and just fits the head. Plates of sheet iron are screwed at each side to prevent angular variation.

The various parts are put together by first passing the mandrel through the coned hole of the disc, Fig. 3, with the large end of the cone towards the tail, then passing the ferrule down the mandrel until it left only about $\frac{1}{16}$ inch play between the disc and mandrel shoulder. A rivet was then driven through a hole previously bored, and the ends slightly swelled with a hammer, I then put the pulley in position, between the supports of the head, and passing the mandrel through a large hole in the front support, drove it through the pulley, and screwed the disc to front face of head. The pulley was sufficiently tight for all purposes, but I made sure by boring a hole through it and mandrel, and putting a wire nail through this hole.

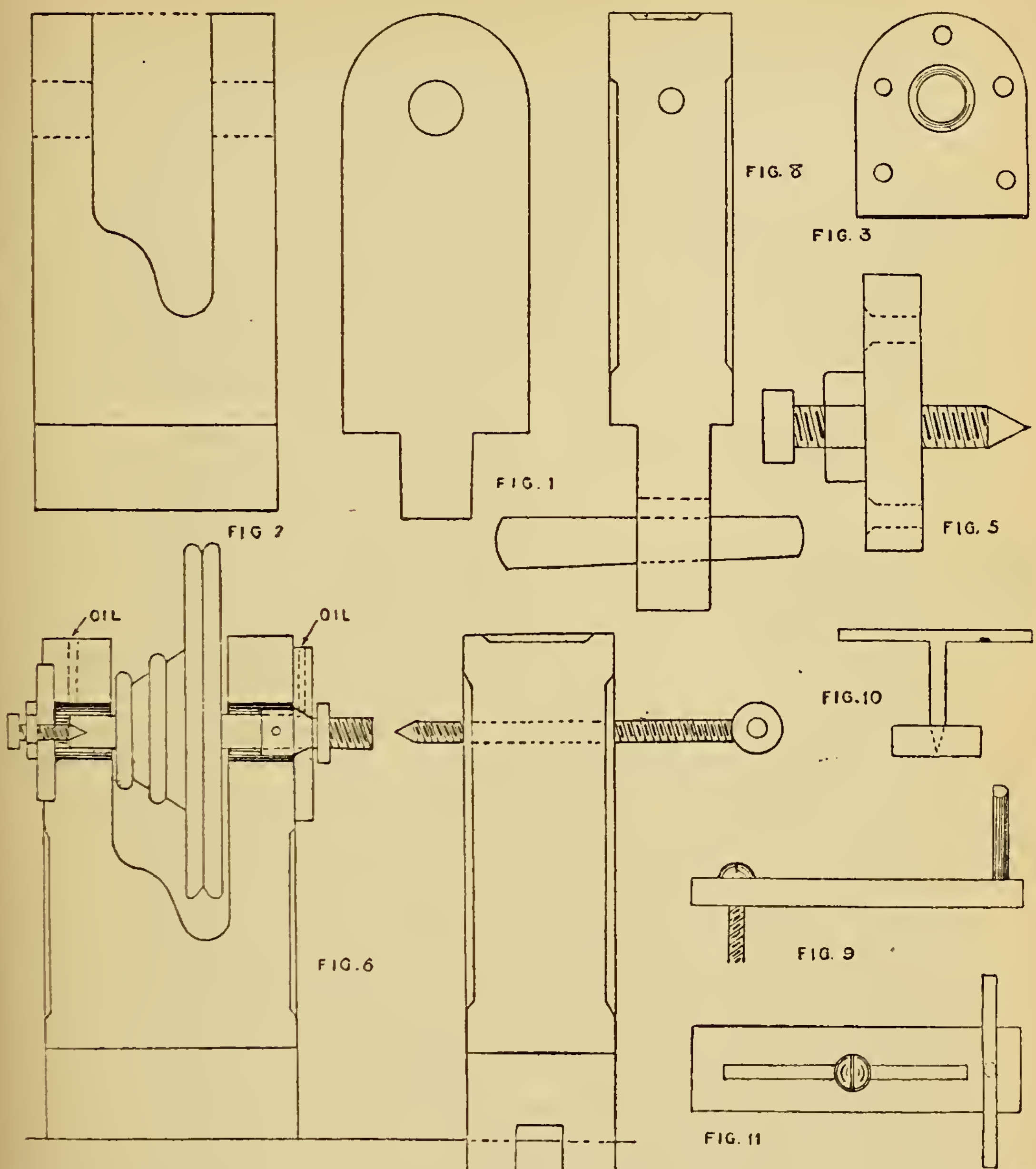
The bar carrying tail-pin is sunk in the head, and is secured by two wood screws. So much for the fixed headstock shown at Fig. 6.

The poppit is a much simpler affair, being only a piece of wood, 3 inches by 2½ inches, and about 15 inches long, having a piece of screwed ⅝ inch round iron, 8 inches long, screwed through it on a level with the mandrel centre. It is fastened to the bed by the wedge, Fig. 8.

The rest is the crudest part. It is a piece of hard wood, 3 inches by 1½ inches, and a foot long, with a slot, ½ inch wide, cut, through which a bolt passes fastening it to the bed. A T-piece, sufficiently high, is driven firmly into the outer end, so that the top is on a level with the centres. Figs. 9, 10, and 11 show it. The figures are to no particular scale, nor are they all to one scale. I enlarged parts as I thought necessary for the clearer explanation of details.

I objected to this rude rest, but my brother, who used it for about a year in another substitute for a lathe, likes it so well that he would not part with it. He keeps the bolt rather loose, clamping by a thin wedge put between the rest and bed. He can move it about with a rapidity only equalled by an eccentric rest.

The bed consists of two bars of wood, 3 in. wide, 1½ inch thick, and about 3 feet long. The tenon of the fixed headstock at one end, and a piece of wood of



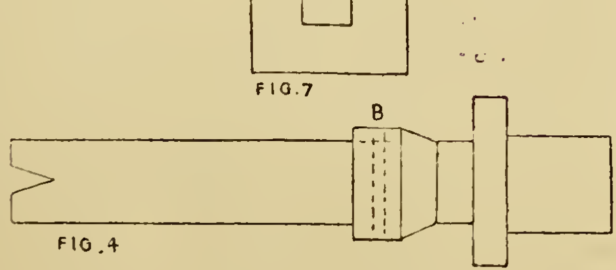


FIG. 1. — FIXED HEADSTOCK, END ELEVATION. FIG. 2.—FIXED HEADSTOCK, SIDE ELEVATION. FIG. 3.—METAL PLATE FOR FIXED HEADSTOCK. FIG. 4.—MANDREL WITH MOVABLE FERRULE B. FIG. 5.—TAIL PIN OF IRON WITH LOCK NUT.

FIG. 6. — PULLEY AND PARTS OF FIXED HEADSTOCK PUT TOGETHER. FIG. 7. — MOVABLE POPPIT, SIDE VIEW. FIG. 8.—MOVABLE POPPIT, END VIEW. FIG. 9.—REST, SIDE VIEW. FIG. 10. — REST, END VIEW. FIG. 11.—PLAN OF REST.

the same thickness at the other, keep the bars apart, while a couple of bolts keep everything rigid.

It is mounted on a bench having a flywheel attached to one of its legs, and the pedal is simply a bar of wood. I may add that the whole cost only a few shillings, at most 5s., and is highly satisfactory.

By bevelling off everything nicely, and sand-papering and varnishing, it may be made a tool that nobody need be ashamed of. If any of our readers find a difficulty in procuring a bit of gun barrel as substitute, I will be happy to supply it gratis if he sends his address to the Editor and stamps to cover postage. Any more particulars with pleasure through "Amateurs in Council."

A "SAND AND TAR" LAWN TENNIS COURT.

By Dr. HEALY.

LAWN TENNIS has become such a fashionable game of late that I am sure many of the readers of AMATEUR WORK will be glad to know how a good and always available court may be made at small cost. Tennis courts are principally of four kinds—grass, gravel, concrete, and asphalt. A grass court is a perpetual trouble and expense. Many prefer it to any other, but it implies much labour and care—and this means expense or fatigue. It must be mown, and rolled, and marked regularly, and with all cannot be used for a great part of the year — a most important consideration in a weeping climate like ours. To those who have only grass courts, lawn tennis is merely a summer game, and who that has played on a hot sultry day but has wished that it was winter instead of summer. All things considered, therefore, most will agree that a grass court is not the best, if one of the others can be had. Many, too, I think, would be willing to change their grass courts for another kind if it could be done easily and cheaply.

I have not much experience of gravel courts, but I imagine that they would require constant care, and should be scuffled and rolled at intervals or else would be overgrown with grass and weeds. Concrete is excellent, if not destroyed by the frost; but the expense is prohibitive. So is asphalt, but the same objection applies here. If, however, the matter of expense could be overcome, no doubt either of the last would be decidedly the best. What I propose is to show how a court can be made at small cost—I will not say equal to asphalt, but I will say good enough for many a year, and sure to give satisfaction to those who take the trouble of making it. I speak from experience.

The ground having been chosen, the first thing to do is to dig it up and destroy every trace of vegetation. If it be in grass, the sods must be removed, and any roots that grow deep in the ground must be taken away. The vitality of plants is something remarkable, and months after the ground has been laid, cracks may appear, through which tiny leaves will begin to protrude themselves, and if left unchecked will soon ruin the ground. Therefore, I say that every trace of vegetation must be destroyed. We are not to suppose, however, that if a stray plant springs up here and there the whole work must be condemned. If any sprouting leaves be carefully destroyed, the root will eventually die, and as no fresh plant can take root the evil will be only temporary.

The ground must now be levelled. I do not know how this is usually done, but here is the plan we adopted, and it succeeded admirably. Procure three pieces of wood of *exactly* the same length — say two or three feet; place two of these some distance apart — say 8 feet, let a board rest on the top of both, and on this place a spirit level. Let one of the sticks be raised or lowered by putting stones under it or digging away the earth from beneath it until both pieces of wood are at the same height. Then mark the spot where they stood, and we will have two spots of exactly the same height. The eye will then be a sufficient guide to level the ground between them. If a spirit level be not at hand a fairly accurate one may be extemporized with a glass of water almost full to the brim. When laid in a surface perfectly level, the water stands at the same distance from the top all round. If otherwise, the water approaches more nearly to the top at the part which is lowest.

Two points having been determined in the way I have described, a third must be found in another direction by the same means, and that being done the work may proceed more rapidly. Taking the third stick, it is placed at some distance in a line with any two points where the level has been already obtained, and, by placing the eye to the top of the stick it is easy to judge when the tops of the three sticks are at the same height. Thus, the work goes on until all over the space to be levelled a number of spots are marked, to which the ground about them must be elevated or depressed as the case may be. This work must be begun not at the highest nor at the lowest part of the ground, but at the spot that seems to be at about the level that will be reached when the elevations are taken away and the hollows filled.

The ground, however, must not be perfectly horizontal. A very slight fall from both ends towards the centre will be necessary; and in the centre, exactly where the net will be, let there be a small channel. By this means the ground will be always sufficiently dry for play, except when the rain is actually falling.

The ground thus prepared must be rolled and rolled again, lengthways and crossways, until the whole is quite hard and smooth. This is most important ; it is then ready for the next operation.

Now procure a few loads of fine dry sand, two large iron pots, one hundred and twenty gallons of gas tar, and a whitewash brush. The tar will be improved if some pitch is mixed with it, and the ground will dry more quickly, but pitch is not absolutely necessary. The tar must now be boiled, and this is an operation that is best performed out of doors—the fire on the ground, and the pot containing the tar suspended from a tripod. If done in the house there is great danger of fire. The pot may be a little more than half filled, if more than that there is the danger of boiling over. It is better to have two pots, the one to be on the fire while the contents of the other are being spread over the ground. While doing this part of the work it will not be advisable to wear one's Sunday clothes. If pitch is used a small quantity must be put with each boiling of tar. When thoroughly boiling, the tar is taken from the fire and poured little by little on the ground, and spread with the whitewash brush, as much tar as can be conveniently spread thus will be sufficient. This part of the work will be almost impossible, and there will be great waste of tar if the rolling beforehand has not been thoroughly done. While the tar is still hot on the ground, dry sand must be thrown on it by hand, much in the same way as the sower casts the corn or seed. Enough sand must be put to completely hide the tar, and so that a roller may be passed over it without sticking. It is better to give too much sand than too little, but any spots that do not get enough at first may get a second dose afterwards. In the middle, and again at the close of the day's work, will be often enough to have the ground rolled while the work is proceeding. The whole spreading of the tar, sanding, and rolling, may be easily accomplished in three days.

When all is completed the ground must be rolled and rolled again. It cannot be rolled too often, as the roller forces the sand into the tar. After a time the tar will begin to appear here and there through the sand, and to stick to the roller, immediately more sand must be applied to those places.

In the meantime let every trace of tar (except what has been spread on the tennis-court) be removed, otherwise you will have no end of trouble ; it will stick to your shoes, and be brought into the house ; it will stick to your tools, to your clothes, to your hands; it will stick to the children's faces and pinafores ; it will spoil the ladies' dresses ; in some unaccountable way it will be found in all kinds of incongruous places. Therefore, let tar barrels, pots, brush, etc., be put out of the way. Cover any spots on the ground where tar has been spilt, with plenty of sand, or burn it, and get rid of all traces of it as soon as you can.

It will now be found that one can walk over the ground or pass a roller over it, but that if one rests or allows the roller to rest for a moment, it will stick. While in this state, traffic must be as far as possible forbidden ; and heels, particularly ladies' high heels, must not be allowed to tread on it.

In rolling, the roller should be brought backwards and forwards, and not turned on the ground ; turning is sure to cause unevenness. When, by rolling and cross-rolling, the whole looks quite level, it may be left, and in due time it will dry.

This last operation is the most trying to the patience, as it may take a considerable time. It will be soon found, however, that in the evenings when the sun has gone down the ground is quite hard, though the next day at noon-tide it seems as soft as ever. When it has arrived at this stage, put up your net, mark your courts, and play whenever it is possible. Wherever there is the least sign of sticking put more sand. Day by day it will be found that play can be commenced earlier in the evening, and soon the hottest sun will be without any effect. Nothing forces the sand into the tar and promotes the drying of the ground so much as good smart play. After the first season, any loose sand remaining may be brushed away, the courts marked in oil paint, and the ground will require no further care.

It is needless to add that the directions I have just given will apply equally well to the making of garden walks, ball alleys, yards, and other purposes that will suggest themselves, as the wants arise.

Finally, a word as to cost. It is impossible to give an estimate as to the labour required, as the time occupied will vary so much with the nature of the ground. When once levelled, half a day will roll it thoroughly, and three days will put on the tar and sand. The expense for sand will of course depend principally on the cost of carriage. Three or four good cartloads will be sufficient. Gas tar is sold in this neighbourhood at 2d. a gallon, which makes £1 for the hundred and twenty gallons required. I imagine that in most places it can be obtained at a much cheaper rate. If you have no tar pots these must be purchased at, say, 3s. each : they will not be of much use afterwards, though I am told they can be thoroughly cleaned. Taking everything into consideration, £3 ought to cover the cost, and less if labour has not to be paid for. I know of two tennis grounds that are side by side. The one was made by a tradesman, and cost £20 ; the other was made by an amateur, who directed a common labourer, and the cost was £3. The cheaper court, made in the way that I have just described, is by far the better.

HOW IT WAS MANAGED.

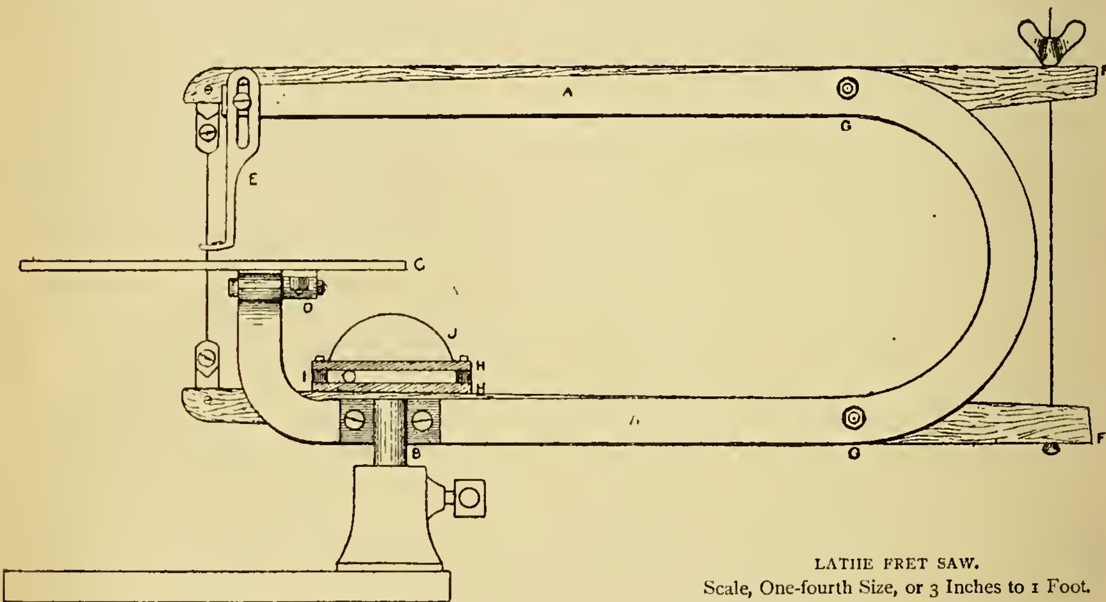
A SERIES OF PRACTICAL HINTS, SUGGESTIONS, AND WRINKLES.

FROM AMATEURS FOR AMATEURS.

XII.—LATHE FRET-SAW.

[*From A MINER.*]

SEEING that you have given A. W. W. permission to send a description of his fret-sawing attachment for lathe, I send you a rough drawing of mine, that I have made, to work on my 4-inch back-geared lathe (also my own make). You will see it is a modification of our clever friend, Olla Podrida's machine, described in Vol. IV., p. 571. I have drawn it $\frac{1}{4}$ size as near as I can. The frame, A, is 1 inch by $\frac{1}{4}$ inch iron, with a T-piece, B, screwed on to fit in rest-socket. The saw table, C, is clamped (at any angle) to frame, A, by a small bolt passing through an eye at end of frame, A, and a lug, D, screwed to under-side of saw table. E is a foot to prevent work from lifting by up-stroke of saw. It is clamped to top arm, A, and is adjustable by slot, E. F, F, are the wood arms (for carrying saw), working on pins at G, G. H, H are two pieces of iron, 3 inches long by $\frac{1}{2}$ inch, screwed to wood arm, with a piece of leather, I, I, between each end to form a slot for the crank-pin to work in. J is a small face-plate to screw on lathe mandrel-nose, with crank-pin to work in the slot. I turn the rest-socket around on lathe bed, as most convenient for holding the saw-frame.



LATHE FRET SAW.
Scale, One-fourth Size, or 3 Inches to 1 Foot.

XIII.—A TELEPHONE FOR AMATEURS.

[*From S. G. HORTON.*]

HAVING read in AMATEUR WORK the papers on "How I Made my Telephones," and "A Carbon Transmitter," I at once proceeded to devise a combination of the two, which I have just completed, and which gives excellent results. Thinking that, perhaps, some of "our" readers might like to construct a similar instrument, I will proceed to describe it. As the instruments for both stations are precisely similar, except as regards the connections, it will suffice if one is described, and the connection with the other afterwards.

It consists of a box of $\frac{1}{2}$ inch pine, dovetailed together, measuring $9\frac{1}{2}$ inches long, 8 inches high, and 5 inches from front to back (all inside measurements). The front consists of a piece of $\frac{3}{4}$ inch pine, hinged to the bottom, and fastened up with a hook and eye at each end. The call bell is screwed to the inside of the right-hand end, and the two Leclanché cells necessary to work it stand in the box.

The carbon transmitter, as described in Vol. IV. of "ours," is fastened by a screw from the inside to the middle of the front, outside. The telephone, when not in use, is hung on the hook A (Fig. 1), which forms the long arm of the switch E (Fig. 2). When it is required to use the telephone, and the latter is unhooked, the switch is drawn down to the telephone contact F by the india-rubber band O looped round the eye of the switch and the screw P.

The bell switch B has a weight of lead at its outer end, so as to keep it against the upper contact, except when it is required to ring the bell at the other station. Fig. 2 shows the connection on the inside of the front. A is a wire attached at one station to the zinc, and at the other, which we may call No. 2, to the copper. The screw B, on which the bell switch is pivoted, is connected with the line wire terminal C. The contact D, against which the switch B rests in its normal position, is connected with the pivot screw E of the telephone switch. The upper or normal contact of this is connected with one of the bell terminals M; the lower one, against which it rests when the telephone is

unhooked, is connected with one terminal of the telephone by the double flexible cord H, and the other terminal of this is connected with the microphone (transmitter) at T. The other wire from this runs to the carbon pole of the battery S_1. The carbon pole of the other battery S_2 is connected to the other terminal K, and also to the terminal of the bell R. At station 2 the connections are just the reverse—viz., those connected to zinc at I are connected to carbon at 2, and *vice versa*. In Fig. 2 the front is supposed to be unfastened and folded down in front. The boxes are looped to the wall by the wire or cord at the top of Fig. 1. The cells used are the small-sized Leclanché.

Suppose the person at No. 1 station wishes to speak to a person at No. 2, he lifts up the switch at the right-hand side of his box for a few seconds, and waits till his bell rings. When No. 2 hears his bell ring, he waits till it ceases, and then raises his switch for a short time. Both then unhook their telephones and converse; and when they have finished both hook up their telephones, which leaves the instruments ready to receive a call from either end.

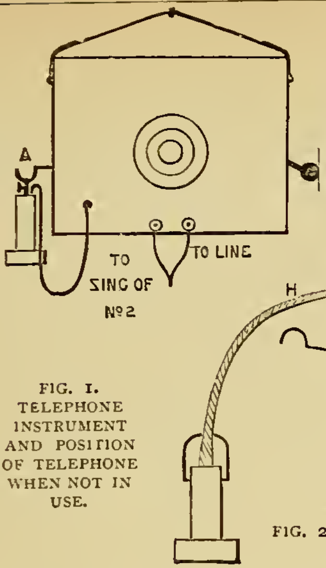


FIG. I. TELEPHONE INSTRUMENT AND POSITION OF TELEPHONE WHEN NOT IN USE.

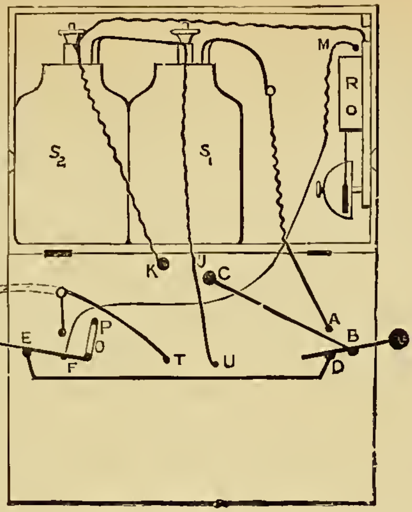


FIG. 2.—ARRANGEMENTS OF BATTERIES, WIRE SWITCHES, ETC.

XIV.—AN ELECTRIC ALARM.

[*From S. G. HORTON.*]

HAVING sometimes to rise early, and having slept through the noise of ordinary alarm-clocks after having answered to their summons for about a week at a time, I cudgelled my brains for a long time to devise some sort of electric alarm in connection with a clock, and at last hit on the following plan.

I procured for the sum of 7s. 6d. a 30-hour clock, in a plain wooden case, and, taking out the dial, made one of thick cardboard with the help of a pair of compasses. At each of the quarters, and in the path of the minute hand, I made two slits with a narrow chisel about $\frac{1}{3}$ inch apart and $\frac{1}{4}$ inch long, and radial to the circle. At each hour, and in from 4 to 9 inclusive, and in the path of the hour hand, I performed a similar operation. Through each pair of these slits I passed a strip of thin copper, of the thickness of writing-paper and the width of the slits, long enough to double over itself at the back, and then soldered the ends together. To all and each of these at the back I soldered a piece of silk-covered wire, about 7 inches long. These were now led up through holes at the top of the case, and so arranged that the wires from the quarters came out on the left, in order ($\frac{3}{4}$, $\frac{1}{2}$, $\frac{1}{4}$ hour), and the ones from the hours also in order on the right (9, 8, 7, 6, 5, 4). To the ends of these were soldered small brass contacts, about twice the size shown in the diagram, Fig. 1. Each of these was nailed down with the head half of a pin. At about $\frac{3}{4}$ inch behind these is a brass wire "horse" (Fig. 2), under which slides a piece of brass bent to the shape shown in Fig. 3. This

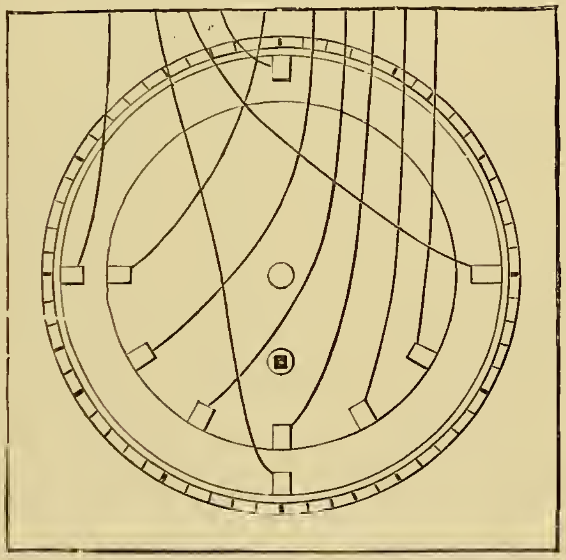


FIG. I.—PLAN OF DIAL AND WIRES TO BRASS CONTACTS.

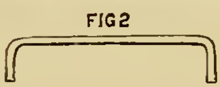


FIG. 2.—BRASS WIRE HORSE.

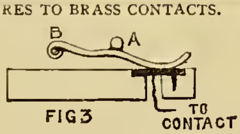


FIG. 3.—BRASS UNDER WIRE HORSE.

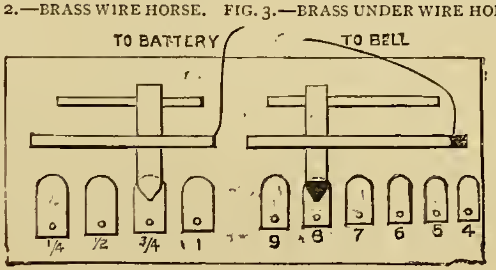


FIG. 4.—ARRANGEMENT OF CONTACTS.

piece of brass slides along another horse E, Fig. 3, around which it is bent. Fig. 4 shows the arrangement of the contacts, the wires to the bell and battery proceeding from the two horses first mentioned. To set the alarm, slide the hour contact to the terminal of the wire from the hour during which you wish to be woke, and the quarter contact to that of the wire from the quarter at which you wish it to ring.

Now as to the completion of the circuit: To each of the hands of the clock and its outer end is soldered a strip of very thin copper. That on the hour hand must be first bent straight down towards the dial, and long enough to reach it, and then at right angles, so as to lie flat on it. It must be long enough from the bend to the point to reach from one hour contact on the dial to the next. That on the minute hand need only be long enough to give a good contact with the quarter contacts. When the hour hand comes to the hour for which the alarm is set, and the minute hand to the quarter, the current passes through the two hands and rings the bell.

NOTES ON NOVELTIES.

By THE EDITOR.

7. Metal Plates for Fret Work. New Designs and Lists from Mr. Henry Zilles. 8. Craig's Bronze Painting Materials. 9. Leicester Utility Co.'s Specialities. 10. Le Page's Carriage Glue.

7. Metal Plates for Fret Work. New Designs and Lists from Mr. Henry Zilles.—There is many a fret-worker and wood-carver, without doubt, who would like to make ornamental metal fittings for the various articles they make, or, at all events, for such of them to which metal fittings would prove an acceptable and appropriate addition, if they only knew where to procure suitable metal that could be cut with as little difficulty, or nearly so, as wood. Sheet metal in every form adapted for the purpose has been brought within the reach of all who wish to obtain it, by Mr. Henry Zilles, 14, *South Street, Finsbury, London, E.C.*, whose specialities I have frequently had occasion to mention with praise in these pages. The plates or sheets to which I am alluding are of zinc, the various specimens which were submitted to me, and were three in number, being plated, one on one side only, with nickel; another on two sides, with brass; and a third, on one side, with copper; the surface of all being highly polished. These plates are 17 inches long, 11 inches wide, and $\frac{1}{32}$ inch thick, and may be used for marquetry, perforated metal work, mountings, as shown in the design for a Jewel Box, in Sheet 709 of Mr. Zilles' designs; and metal ornaments, such as escutcheons for key-holes, hinges, corners, vases, etc., for which many patterns of excellent design are given in Sheet 744, which I heartily recommend to the notice of my readers.

The use of this sheet zinc is certainly calculated to impart a more finished appearance to those articles of fretwork and marquetry with which it can be used. It can be cut with a saw or sharp tool, pressed, stamped, bent, beaten, punched, and soldered with ease, and, what is equally to the point and purpose, without injuring the polish on the sides. It will never oxidise or get rusty, or exhibit the presence of verdigris. Designs may be traced on the polished side by means of blue or red copying or tracing paper, and they can be removed at pleasure with a damp cloth, without leaving any traces of the drawing. Holes can be drilled in the plates with an ordinary drill, and the pattern can then be cut out with a fret-saw in the usual way. The most suitable saws for this purpose are Nos. 0 and 1 of Mr. Zilles' "New Patent Champion Fret-Saws," whose teeth are exceedingly small and fine, and are as well adapted for cutting bone, ivory, very hard wood, and metal, as the Champion Saws, noticed in Vol. I., page 300, are for cutting wood, horn, etc., on whose principle, indeed, they are constructed. The "New Patent Champion Fret-Saws" are made in five sizes only—namely, Nos. 0, 1, 2, 3, and 4—and are sold at 5d. per dozen, or 2s. 6d. per gross. During the process of sawing, the saws should be frequently lubricated, and for this purpose spermaceti ointment will be found a useful lubricant. To return to the metal plates, I may add, for the information of my readers, that their prices run as follows—namely, for sheets nickel plated on side, 3s. 6d. each; on both sides, 4s. each; and the same prices rule for the brass and copper plated sheets; but those surfaced with copper are plated on one side only. With respect to these copper-plated sheets, Mr. Zilles points out that they cannot be made without having some small stains on them here and there; but as this kind would be used only for small articles, the presence of an absolutely uniform tint throughout does not materially interfere with its utility.

My opinion as to the beauty and artistic excellence of the German designs, and with regard to their manifest superiority over most others, whether of English or American origin, is pretty well known by this time; and I need only tell my readers that there are many treats in store for them in the designs for fretwork, wood-carving, etc., in those comprised in Nos. 721 to 744 inclusive, recently published by Mr. Zilles. Most of these are exhibited on a small scale in Mr. Zilles' New Miniature List, No. 24, which will be sent post free to any applicant on receipt of 4d. in postage stamps. Many of the designs in this list bearing numbers lower than 721 are entirely new, Mr. Zilles tells me, and supersede, I presume, cancelled designs which formerly bore the numbers that are now attached to the new ones. Sheet 709, which contains the design for the Jewel Box mentioned above, also contains a good design for a Cigar Stand in fretwork, which some of my readers may like to make. I do not smoke myself; but then tastes differ in this as in many other things, including the much-vexed question of fretwork designs.

8. *Craig's Bronze Painting Materials.*—In Vol. III., page 382, of this Magazine, I had the pleasure of calling attention to some excellent Transfer Gold Leaf and Gold Bronze Powder, specialities supplied by Mr. Walter T. Craig, *Wick, N.B.*, and letters subsequently received from various correspondents confirmed my estimate of the value of Mr. Craig's preparations, and bore valuable testimony to

their utility. Since that time Mr. Craig has been turning his attention to the production of appliances for what is called "Bronze Painting," the result being a well-made and nicely finished japanned case, 9 inches long, 5½ inches broad, and 1 inch deep, provided with every requisite for this branch of the painter's art, comprising a china palette measuring 3 inches by 1⅝ inch by ⅝ inch, and containing three divisions, four brushes, a bottle of spirits of turpentine, another of the medium used in bronze painting, and fourteen of the most useful bronze colours—namely, Carmine, Rich Old Gold, Scarlet, Flesh, Bright Gold, Deep Orange, Bright Blue, Crimson, Silver, Copper, Citron, Lilac, Black, Peacock Green. The price of the box complete is 10s., and I believe I am correct in thinking, that having regard both to quantity and quality, there is no box of painting materials of a similar kind that can be obtained at so low a price. The bottles of coloured bronzes can be had separately at 4d. each, with the exception of Peacock Green and Bright Blue, which are 9d. each. In addition to the colours named above, as being contained in the box, Blue Steel, Green, Deep Gold, Green Gold, Deep Copper, Rich Pale Gold, and Orange can be obtained and bronzes can be made to any shade that may be required. This knowledge may be of importance to some who may desire to have a set of colours, different in some respects to those that are mentioned above, as being included in the contents of the box. With regard to prices Mr. Craig says: "Although the prices quoted above are not more than half, and in some cases considerably less than half, those usually charged, the quality of the bronzes cannot be surpassed and the bottles are full size. No half-size bottles used. The medium renders the bronze perfectly impermeable to any climate or atmospheric influence, and protects it from becoming tarnished. Bottles of the medium are supplied at 6d., 1s., 2s. 6d., and 5s. The bronze colours are useful for painting on any description of textile material, and if the fabric can be washed, the medium, when used with the colours, will prevent any injury resulting to the paintings from the operation of washing. The colours can be further applied for the decoration of wood, as in carved work, cabinets, chairs, door-panels, etc. The work is easily and quickly done, and presents a highly attractive appearance when finished. Full instructions for the manipulation and use of the colours and the production of high lights, shadows, etc., are supplied with every box. For my part I consider Mr. Craig's Bronze Painting Materials and Case both good and cheap, and being so, I can heartily recommend it to amateurs who wish to execute paintings on textile fabrics.

9. *Leicester Utility Company's Specialities.*—Since I had an opportunity of testing "Tripoline" in the powder form, I have received from the Leicester Utility Company, 10, *Yeoman Lane, Leicester*, a box of the same metal polish in the form of paste. It is as good as a polishing paste as it is a polishing powder. I have tried many preparations for cleaning brass, especially such articles as are found among the tools and appliances of an amateur mechanic, but I have never yet met with any preparation that does its work so quickly and effectively. Nothing more is needed than a piece of rag wherewith to apply the Tripoline to the brass to be polished, and a piece of soft cloth or leather for giving the final rub up. The Leicester Utility Company is a young company at present, and has not yet attained to the dignity of a catalogue. It has been set on foot for the purpose of buying and bringing into the market inventions of general utility that appeal to the wants of a very large section of the community, and are likely to meet with a large sale on this account. "Tripoline," whether in paste or powder, is prepared solely by the Leicester Utility Company, and is sold by all ironmongers, grocers, oilmen, etc., in boxes, at 1d., 2d., 3d., 6d., and 1s. each. The Company prepare a Tripoline Knife Powder, guaranteed free from emery, in packets and tins at 1d., 3d., 6d., and 1s., but this I have not yet tried.

10. *Le Page's Liquid Fish Glue.*—Correspondents, as a rule, speak in the highest terms of this most useful preparation, but an exception to the rule turned up lately in a letter from some one who had tried it and found it, according to his own account, no better than gum water. It is possible that he may not have got the "Carriage Glue," which is the best for wood-workers, and is reputed to be of such strength and tenacity that it will hold iron and wood together; for other qualities of this glue are made, as, for example, "Bleaching Glue," which is made for sizing straw goods, and obviates the necessity of bleaching straw, by exposing it to the fumes of sulphur. Again, No. 16 Glue is expressly prepared for boot and shoemakers; No 20 X, for sizing textile fabrics; O. C. Glue for the manufacture of table oil cloths; No. 20 F, for gummed paper and envelopes, for making court plaster, in the manufacture of artificial flowers and in taxidermy; and, lastly, there is the "Liquid Glue," sold in small bottles, which will mend china. Thus many different kinds of the Fish Glue are made for different purposes, and correspondents, when writing for glue for woodworking, should ask for *Carriage Glue*. It must be remembered that the Fish Glue is prepared by the Russia Cement Company, *Gloucester, Massachusetts, U.S.A.*, of which Mr. Le Page is a member. The first agent for the sale of the Glue in this country was Mr. Theodore Eckhardt, who has since died. When he became too ill to carry on his business, he was assisted by Messrs. Phillips and Co., 96, *Milton Street, Chiswell Street, E.C.*, from whom the glue may now be purchased, but they obtain it from Messrs. Richards, Terry, and Co., 46, *Holborn Viaduct, E.C.*, who are the direct representatives and agents of the Russia Cement Company in this country.

Since writing the above I have been favoured with a communication from Messrs. Richards, Terry, and Co., fully confirming all I have said above, and which will be found in "Amateurs in Council" in this Part, or the Part for February, as the exigencies of space and the observance of precedence in regard to giving publicity to the queries or otherwise of correspondents will admit. Some confusion has arisen owing to the connection of three names with the glue in question; but the haze that has enveloped the matter is now cleared away, and no further inquiries will be necessary as to how or where this most excellent and useful glue can be obtained.

AMATEURS IN COUNCIL.

1. Contributors to AMATEUR WORK *and Correspondents asking or answering Questions in "Amateurs in Council," are requested to write on one side of the paper only.*

2. When Illustrations or Diagrams are necessary, draw them on a separate piece of paper, because the "copy," as the manuscript is technically called, has to go to the printer, and the illustrations to the engraver.

3. Abstain from the epistolary form, as it is utterly unnecessary, unless in letters of business. Put the question you wish to ask, or the reply you wish to make, as briefly as possible, and write every separate question and every separate reply on separate pieces of paper. Sign each with initials, nom-de-plume, or name and address, as preferred.

4. Let every paper be headed AMATEUR WORK, *and follow these words with* "Information Sought," *when it is a query;* "Information Supplied," *when it is an answer to a query; and* "Sale, Purchase, and Exchange," *when it concerns anything to buy, sell, or barter.*

5. It must be fully understood that no attention will be paid to any letter or communication in which these rules are not rigidly observed.

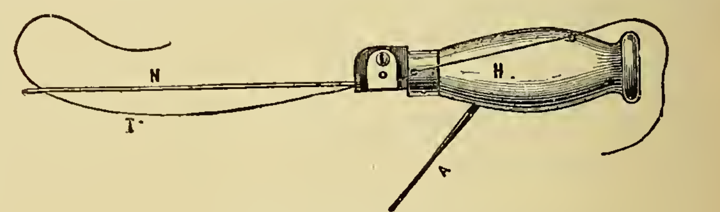
[The Editor reserves to himself the right of refusing a reply to any question that may be frivolous or inappropriate, or devoid of general interest. Correspondents are requested to bear in mind that their queries will be answered only in the pages of the Magazine, the information sought being supplied for the benefit of its readers generally as well as for those who have a special interest in obtaining it. In no case can any reply be sent by post.]

Improvement of the Rogers' Scroll Saw.

H. W. B. B. (*St. Helena*) writes:—"Many of the readers of your useful columns are doubtless the possessors of a Rogers' Scroll Saw, and a lathe of 3 inch centre, or thereabouts. To such, I propose to give a few hints which will materially add to the utility of their 'plant.' The Rogers' Scroll Saw is perhaps the best of the cheap machines, but it has its defects. One of them (as every amateur who has used it much will admit) is the want of power in the flywheel to cut anything over ¼ inch thick without undue back and leg-ache. By fitting the machine to the lathe you will obtain sufficient power to at least treble its cutting power, and the arrangement is simple in the extreme; indeed, I hope to dispense with sketches, and make my meaning clear by description. I will begin by saying my own lathe is a plain 3 inch centre, by the Britannia Company, but mounted on their No. 13 lathe stand, which has a very powerful wheel. And to digress for a moment, I advise all fitting out at home, or for the Colonies, who can possibly manage it, to pay a visit to the works of this firm at Colchester; I did so, and received every courtesy and many useful hints regarding my wants. Their works are worth inspection, and having a fair assortment of their tools, chucks, etc., I can bear testimony to their accuracy, durability, and economy. To proceed with our fitting, first unscrew the iron frame which carries the arms and spindle of the fretsaw from the legs. You will see the hole for bolt of *front* legs does not go through the whole frame. With a suitable drill, bore it right through and remove the spindle and pulley from their bearings. Now get a bolt and nut long enough, and bolt the frame to the lathe bed. Fix the spindle in any suitable chuck, centrally, and bring the lower arm up to the eccentric (now reversed from its old position against the arm). Put the screw through, and you are ready for work. I think the result in additional cutting power will amply repay you, while the absence of vibration increases the accuracy of the stroke. Sheet brass let into the slot of lower arm will much reduce the friction. I have tried fret machines of every principle in the market, and have never been so satisfied as with this arrangement, and Griffin saws. The vertical slide machines are correct in principle, but hard to work, and difficult to insert saw in work; and after a long experience in fretsawing, I consider moving arms with pivot clamps, and a guide under the table, the best all round arrangement. But shall we discard our old 'Rogers'' stand and treadle? By no means. Bolt a top of inch deal to the legs, as a table, screw your small grindstone and trough to this, and fix pulley of the fret spindle to end of grindstone spindle, connect with driving wheel, and you have a capital treadle grindstone. Before concluding, let me thank you for the invaluable help I have obtained from the pages of AMATEUR WORK. I dabble in most branches of mechanical work, and welcomed the Magazine from another Colony (Jamaica), p. 93, Vol. I. But I scarcely anticipated such an aid to every one of my hobbies as it has proved. 'Ours' has shown where to buy and how to use the many handy tools and novelties noticed, and given many a hint for house, garden, poultry yard, and workshop. I wish some of your talented contributors could drop into my drawing-room or workshop, and see their pretty designs in the 'solid,' and their 'ways and means' profited by at the hands of an enthusiastic, though I fear, at times, impatient amateur. In this isolated community, the scene of a mighty worker's exile, a non-professional workshop is a curiosity, and mine is, I believe, the only one existing, most of the inhabitants having apparently, never dreamt of household repairs, or original construction at any but paid artificer's hands! Needless to say, my leisure hour pursuits are, by some '*lardy dardies*,' criticised a little disdainfully. The more envious say, 'Where on earth did you pick up all this 'ere? Have you learnt engineering, etc.?' I point to 'Every Man His Own Mechanic,' and the three bound volumes of 'Ours,' and say, 'there is the *mine* from which anything *sterling* you see originates.' As one result, our American Consul has gone off with E. M. H. O. M., and is busy at roofing and gutters! My duties in the service bringing me for fixed periods to the Colonies, I have learnt by experience one must bring or import *everything* in most places. I cannot even buy a bolt and nut here, and was charged 3½d. yesterday for one small sheet of emery paper! My whole kit, a very complete one, I brought out in two strong chests, measuring 46 inches long by 24 inches wide by 18 inches deep, and placed on one another they make an excellent bench—another hint for emigrants. I shall welcome the papers on Model Engine Work, and should like to see hints on Repairing Racquets, and for *removing* stains, such as the yellow tint from piano keys. Anything I may ferret out myself I will send you, and whatever of above you think worth inserting, please use." [Thank you for your promise. The whole of your letter is worth using, and I give it *in extenso* with considerable pleasure, which is much enhanced when I think that the attempts I have made to advance practical education, and a taste and liking for practical work, among my fellow-countrymen, is, under God's blessing, bearing good fruit. To my readers, generally, I may say that the above letter is from an officer in Her Majesty's service, stationed at St. Helena.—ED.]

Boot and Shoemaking.

F. M. (*Dover*) writes:—"To those amateurs who repair their own boots I can recommend the awl used in Pearson's Patent Patching Process, and shown in the annexed illustration. It is a comparative easy matter to sole and heel boots, but not always so to patch, etc." [This awl is supplied by the patentees, Messrs. Pearson and Co., Boot and Shoe Engineers, 141, *Shoreditch, London, E.*, at 2s. 6d., complete, and post free. With reference to this awl, Messrs. Pearson and Co. say, "No more blind stabbing. The most useful invention ever brought out for sewing on patches, toe caps, loose welts, and block leather heels. Any one who has never used an awl before, may, by this process, sew on patches in the most difficult process after half an hour's practice. No shoemaker should be without one." I have not yet handled this awl, but judging from the illustration, it appears to be a most useful invention, especially for amateurs.—ED.]



PEARSON'S PATENT AWL.

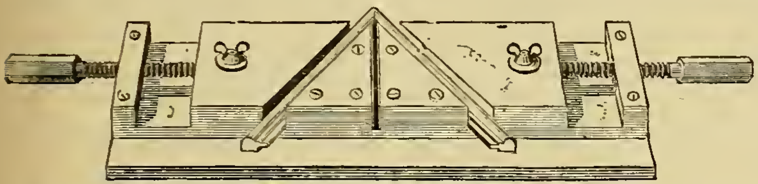
A, Awl; H, Handle; N, Needle; T, Thread.

Model Yachts.

AJAX.—In reply to your query, I must point out that the width of the deck is quite optional, and may be made to "tumble home," or run straight up, or "flare out" from the vertical of the beam on the load water line, just as fancy dictates. I ought to have mentioned that all dimensions, when given in the first instance, are taken *on the load water line*, and not on the deck line, since the calculations for displacement (as will be shown in a future paper) are made from the former dimensions, and these are the only ones which give an idea of the size or tonnage of the model.—A. C. H.

French Mitre Block and Shooting Board.

WAITO writes:—"As PERFECT has at page 503, Vol. IV., opened the question of mitre blocks, I send you a sketch of a French invention. The said sketch does not appear to me quite correct, as I think there should be slots in which the bolts belonging to the thumbscrew should work, otherwise, I do not see how the blocks are to move back and forwards. I am also of



FRENCH MITRE BOARD AND SHOOTING BLOCK.

opinion that the shelf, A, might advantageously be extended on the other side, which would enable PERFECT to shoot his mitres both right-handed. The invention is 'patented without the guarantee of the Government,' but I cannot say if this would prevent amateurs in England making the article for their private use. I cannot say where the block is to be obtained, but I fancy it might be heard of at Tiersot and Co., *Rue des Gravilliers, Paris*, who, by the by publish an excellent catalogue of tools, etc., and can supply anyone wanting one with a set of lead hollows and rounds, as described in Fig. 35, in the article on Making a Treadle Tool-Grinding and Setting Machine (page 476, Vol. IV.)

Britannia Company's Combined Lathe and Fret Saw.

F. R. (*Croydon*).—With regard to the alteration of fret saw, I have much pleasure in answering your question, and only hope I shall be able to make you understand. I

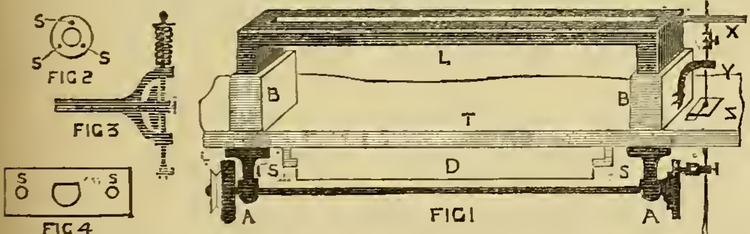


FIG. 1.—LATHE AND FITTINGS.—A, A, Supports for Shaft attached by Screws, S, to under surface of Top of Bench, T; D, Drawer under Bench; L, Lathe Bed supported on Blocks, B; X, Table; Y, Support; Z, Brass Plate. FIG. 2.—PLAN OF SUPPORTING A IN FIG. 1.—S, Screws. FIG. 3.—SPRING AT TOP OF MACHINE. FIG. 4.—BRASS PLATE SHOWING SHAPE OF HOLE FOR SAW JAW THAT IT MAY NOT BE ABLE TO TURN ROUND.—S, Screws.

made a small but heavy flywheel, just like the one on the top of the fret saw, and also a round spindle like the top one, then two supports for the same, and screwed the supports with three screws, S, taking care to have them out of the way of the spindle or you cannot screw them on to the underside of bench (see sketch). I made the under part just like the top, only as if turned bottom upwards. Put a brass plate on the top of bench, and also under, for the saw holder to work up and down in; also, a support fixed to the block that the machine stands on (see sketch). I then made a long fret saw holder to work in the same, took off the pin at the top that works the saw up and down, but left the slot it used to work in, so as to keep the top saw holder from turning round when at work. Put a spring at the top of the machine, as at B (see sketch). This is quite enough for wood up to ½ inch. You can still use the top wheel and spindle with the mitre gear wheels for the vertical drill spindle. If you don't understand this, write to me through the Editor.—J. E. R.

Glass-Blowing for Amateurs.

E. W. C. (*Bradford*).—This subject will be completed in four papers, so you will not have to wait very long before the whole of the matter is in your possession. I am glad to learn that AMATEUR WORK has been so useful to you, and that you have succeeded in making a violin which is pronounced an excellent instrument. I am also obliged to you for the steps you have taken to promote the sale of the Magazine.

Electric Arrangement for Alarum Clock.

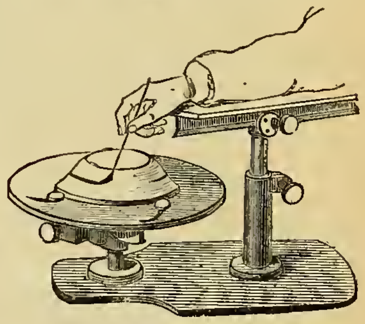
W. D. (*Liverpool*).—Before this meets your eye you will have read, perhaps, M. Marisseaux' description of an Electric Clock in the December Part of this Magazine. I have another article on an Electric Alarum, by the same writer, which will soon appear, and some excellent instructions on this subject from a Woolwich correspondent, which will find a place in "How it was Managed."

Hot Air Motors.

THE BRITANNIA COMPANY write:—"Motor for Lathes is a subject mentioned in AMATEUR WORK. These we are now engaged upon, namely Hot Air Motor, to burn either coke or gas, two-man power, costing 2d. per day for coke; Hot Air Motor, one-man power, to burn either by petroleum lamp or by gas, atmospheric burner, £12. Hot Air Motors are *perfectly safe*, any one can manage them. They are also very silent. We are also bringing out a very effective Gas Engine, which we expect to sell at £16 one-man power, and at about £24 two-man power." [Readers interested in Hot Air Motors will do well to communicate with the Britannia Company on this subject, or to visit their works at Colchester, where they will be able to examine the Company's new gas engine, which I am given to understand, is now complete, and ready for inspection.—ED.]

Wheel for Drawing Circles in Porcelain Painting.

MAD JACK.—The annexed illustration will give you a good idea for making a wheel and rest for drawing lines in pottery and plaque decoration. It is a sketch of a wheel sold for this purpose by an American firm, Messrs. J. Marsching and Co., 21, *Park Place, New York*. Any plaque, plate, jug, vase, cup, or saucer, that is not more than 20 inches, or less than 1½ inch, in diameter,



WHEEL FOR MAKING CIRCLES IN PORCELAIN PAINTING.

placed within the jaws, on the face of the disc, and which move in slots cut in the disc itself, can be centred quickly by turning the thumbscrew on the side of the disc. The hand-rest can be moved forward or backward, to the right or to the left, at any height or angle, according to one or two shafts used, the shorter shaft allowing 10 inches, the longer, 16 inches of direct height. The rest is moved forward or backward, or at an angle, by setting the thumbscrew in either of the two holes on the left side of the head of the shaft, and raised up and down, and held in position by setting the thumbscrew in the head of the pedestal. The decorator, after putting both article and hand-rest in proper position, can revolve the disc with perfect ease with thumb and finger placed upon the milled worm on the hub (with apologies to A. F. S. [*Dresden*] for the use of the word) of the disc. In a few trials, it is said, one can learn readily to handle the brush band, and rim accurately from the finest to the widest line, according to width of brush used. The drawing and description is taken from "The Art Amateur." It clearly exhibits the principle on which these wheels are made, and offers sufficient suggestion to the amateur for making an appliance of this kind for himself.

"Wholesale Damning."

NE QUID NIMIS writes:—"As a regular subscriber to, and carefnl reader of, AMATEUR WORK, I was greatly surprised to notice your recent review of Messrs. Harger Bros.' catalogue, which I consider is unfair in its criticism, and certainly most contradictory to the previons flattering remarks by the same writer. Presumably, the many calls upon a descriptive pen, prove too great a strain to furnish original ideas, and at the same time weaken the memory to a pitiable extent, which may be the pleas for excuse, for the wholesale damning of a list of useful and reliable articles, sold by respectable tradesmen. I have carefully referred to your favourable reviews, in 'Notes on Novelties,' and beg respectfully to call your attentiou to page 140, Part 14, January, 1883, where you 'specially recommended' to fretsawyers various patterns sent by the above-named firm. Page 191, Part 15, February, 1883, where Harger's list prices, etc., are put on a par with those of Messrs. Melhnish and Sons. Page 590, Part 23, October, 1883, which bears Editorial testimony to the 'beauty of design, and utility of purposo' of the Yorkshire firm's designs. Part 27, page 181, February, 1884, where the now despised 'sixpennyworth,' but then 'fourpennyworth,' you remark, 'Cannot fail to be useful to amateurs generally.' Again, on page 537, Part 34, September, 1884, where you notice Messrs. Harger Bros. as the 'Well-known-north country dealers in fretwork materials;' and finally (of the complimentary series) to page 591, Part 35, October, 1884, when your friendly disposition towards the north-countrymen was appareutly undisturbed, at least the wording conveys that idea. I am not, as you may, perhaps, infer, paid to submit this letter, but do so in fairness to persons whose goods I have purchased and tested, always to my entire satisfaction. I have no desire to write in disparagement of other firm's lists, but must suggest to you that the *German* patterns are very inferior to others, most good fret-cutters refusing to waste their time and wood in making them up. The overmantel you refer to (although I do not like overmantels of any description) I think, is cleverly treated, and contains a clear, yet bold pattern throughout. The other pattern to which yon allude, I think, though, perhaps, in point of architecture, etc., is weak, is still superior to the rubbish sold by some dealers, as *artistic* (?) fret patterns. Trusting, after the perusal of this letter, and reference to your own notes, you will not be too severe in your criticisms in future, and will give this publicity." [I am disposed to think that when the gentlemen, whose cause you champion, have read your letter and my rejoinder, they will be inclined to say, "Save us from our friends," but as you challenge me to give publicity to your letter, and would doubtless think that if I suppressed it, I was actuated by motives other than those of the utmost consideration, both for Messrs. Harger Brothers and yourself as well, I am reluctantly compelled to permit its appearance in type. I pass over with intense amusement your charges of unfair criticism, self-contradiction, and overtaxed brain — which, you aver, has drawn me into "wholesale damning of a list of useful and reliable articles sold by respectable tradesmen"—your bad opinion of the German patterns, and your good opinion of your own taste and judgment, and proceed at once to ask you if you know what is meant by "reading between the lines?" On reading the critique of which you complain, those who are accustomed to carry out this mental process would at once see that Messrs. Harger Brothers had desired me to notice their catalogue and specialities according to their own view of them, instead of sending what they did send without comment, and leaving me to form my own judgment upon those things which they chose to submit to me. My criticisms, one and all, are honestly written, according to the positive merits of the articles that are submitted me, and unless this principle and purpose is strictly carried out in criticisms of every kind, they are nothing more nor less than a miserable fraud and a mean attempt to hoodwink buyers, and pander to sellers. As to any depreciation of Messrs. Harger Brothers' Catalogue, my notice itself shows that instead of "damning it wholesale," to use your own forcible but not too beautiful expression, I said that it was one that I myself was glad to have within my reach, though I declined to say it was "the most complete of any published." As to the German patterns, Messrs. Harger Brothers and yourself are free to enjoy your own opinion, but you must not expect me to abandon my own opinions and fall in with yours, because your notions in these matters are not on all fours with mine. Further, in nothing that I advanced in the criticism to which you refer, can it be said that I have written in opposition to previous notices, and I now confirm every sentence of which it is composed. As to the German designs, I repeat that, speaking generally, they are infinitely more artistic and superior in design to those of English and American origin. Lastly, let me say that my criticisms have always been free from outside influence of any kind, and always will be, and in this, I imagine, lies their value. Your nom-de-plume asserts that in your letter you neither say too much nor go too far. Under the light that my remarks have thrown on the criticisms to which you choose to take exception, I trust you will see that you have been very near to doing both, if you have not actually done so.—ED.]

Deadening Noise in Repousse Work.

K. A. T.—The metal in repoussé work is usually laid on a thick sheet of lead, or else a bed of pitch and wax, while the design is being hammered out. If you have no better means than hammering it out on a board, a thick sheet of gutta-percha, or baize cloth, laid between the board and table would greatly mitigate the noise. In my forthcoming articles on "Repoussé, or Stamped Metal Work," I shall give full directions for working processes.—H. C. STANDAGE.

Engravings Creased by Folding, etc.

W. S. M.—Lay the creased engravings, face downwards, upon a looking-glass, or some other perfectly smooth and hard surface. Rub the back of the engravings gently, but firmly, where creased, with a paper-knife, or the bowl of a tablespoon. Pass a sponge slightly wetted with clean cold water over the whole of the back of the print. Lift it carefully on a sheet of cartridge paper, and reverse, so as to bring the face of the engraving upwards. Place another sheet of paper over the print, rub the creases gently down. Pass the wet sponge carefully over the whole of the face, taking care to leave no superfluous moisture thereon. Dry between sheets of blotting paper, placing books or other weights to keep the engraving smooth while drying. For more details, *vide* Vol. III. AMATEUR WORK, Part 32, page 430, "Repairing of Damaged Engravings."—J. B.

Making Accumulator.

MAGNET.—I think that I have hinted more than once that it is a waste of labour for an amateur to make an accumulator for lighting lamps. The expense and labour is very great, and the result unsatisfactory, for the plates must be "formed" under a powerful current of electricity only obtainable practically from a good dynamo machine. Then they should be charged from a similar source, and are therefore useless in a small way.—G. E.

Chloride of Silver Battery.

MAGNET.—Procure as many plates of silver foil as you require elements in the battery, and of a size corresponding to the volume of current desired. For a five-candle lamp you would require about ten plates, each 1 foot square. Dissolve a quantity of silver in nitric acid, drive off excess acid by heat, dissolve the crystals of silver nitrate in distilled water, add muriatic acid until all the silver has been thrown down as a white precipitate, which will be chloride of silver. Decant off all liquid from this, and dry it to a paste. Spread some of this paste to ⅛ of an inch in thickness on each silver plate, and heat it over a gas stove until the paste dries and fuses into horn silver. Or, dry a layer on each plate, carefully fold the same in one thickness of blotting paper, and thus prepare the silver plate. On each side of the silver plates place corresponding plates of zinc, wrapped in thin flannel soaked in a solution of zinc chloride, made by dissolving zinc in muriatic acid. Place each set of elements in stone, glass, ebonite, or insulate cells, and connect the zincs of one cell to the silver of the next, and so on to the end of the series. Now, I have told you how to make it, estimate the cost, and when I tell you that it will give light for about an hour, kindly say whether you think the game will be worth the candle.—G. E.

Flageolet Pipes for Organ.

JOINER.—You can make all your metal flageolet pipes as proposed. The papers on Metal and Reed Pipes are in the printer's hands, and will shortly appear. The delay has been caused by ill-health and pressure of my ordinary work.—M. W.

Glasses for Beetle Traps.

W. H. T. (*Notts.*)—These may be purchased of oil and colourmen, and those who sell brushes and turnery of all kinds.

Amateur Photography.

R. R. (*Belfast*).—The subject of a series of articles for amateur photographers is under consideration. As I have said in a reply to another correspondent, Mr. Benwell will deal with backgrounds at some future time.

Designs for Panels in Fret Work.

W. G. B. (*Limerick*) asks for designs for panels in fret work for a folding screen, the topmost panel being 18 inches by $4\frac{1}{2}$ inches, and the lower 18 inches by 10 inches, there being another panel of tapestry work between them. Such designs, if given full size, would cover 261 square inches, which is equivalent to the space occupied by type in nearly five and a half pages of the Magazine. I have given you alternative designs one-sixth full size, or, in other words, on a scale 2 inches to 1 foot. You must enlarge them yourself to full-sized working drawings. Mr. J. W. Gleeson-White has been kind enough to supply these designs in accordance with your request.

Ferns for Mounting Stuffed Animals.

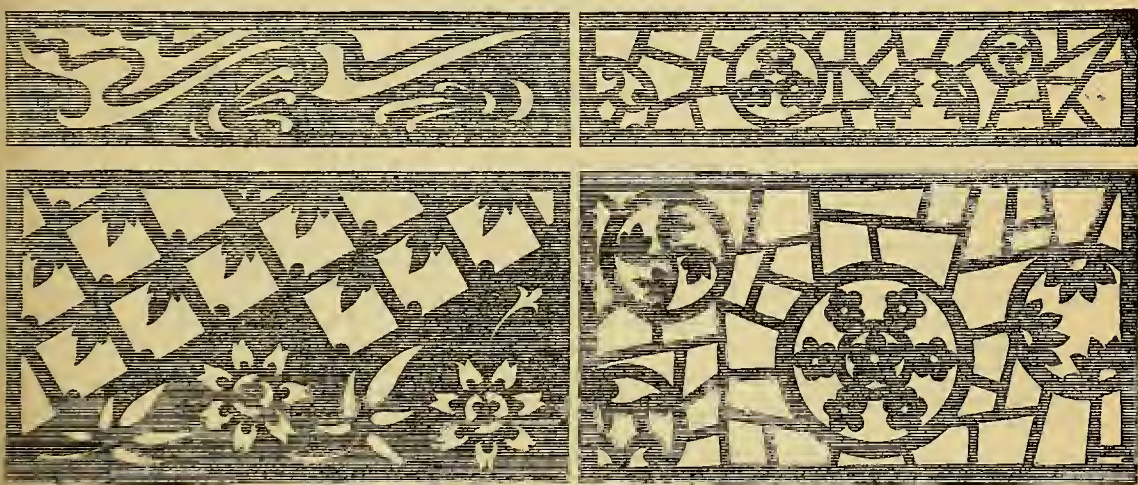
E. W. writes in reply to PRESERVER:—"Ferns for case decoration should be dried between sheets of botanical paper, or the leaves of an old book. When quite dry, they may be coloured to the desired tint by means of ordinary oil-tube colours, thinned down with turpentine. A little varnish should be added to give the gloss of nature, without undue shininess. If required to stand out tuft-like, as in nature, the fern must be strengthened by means of fine wire fastened alongside of the rib or stem at the back. This should be done with the dry fern, the whole being coloured afterwards. The wire allows of the fern being bent gracefully over, as in nature. A number of fronds may thus be worked together into a very close resemblance to the natural plant; and all signs of art may be well concealed."

Punch and Riveter.

OLLA PODRIDA writes as follows to A. F. S. (*Dresden*):—"Surely your own superabundant mechanical ingenuity can help you out of this? Cannot you devise an 'improved' one to suit your own very special requirements? If you were to direct some of the talent you possess for inventing queries, into another groove, you might benefit greatly thereby. But I wonder, now, whether you *really* want an appliance of the above description, and if so, why do you, with your advanced experience, prefer punched to drilled holes? Do you contemplate an extension of your works (!) so that boilers '24 inches diameter' may be accommodated? Would you be kind enough to complete the query by giving the *length* of those 24 inch boilers, or state which seams you are designing to close; the information would be very handy to business people with lots of leisure wherein to open up a new field. But, to my mind, the most beautiful passage in your query is contained in the closing sentence—'It MAY work by screw, but lever *preferred!*' There is something so truly magnanimous about the word 'may' which is altogether inexpressible. You are merciful indeed in thus leaving the gate of option open, but, glorious as the opportunity for distinction undoubtedly is, I, for myself, decline the honour. I will, however, venture a hint as to what you might—but as a matter of course, never will—do. Get an ordinary 'bear' and modify it to your needs. You know what I mean. Adios!"

Carbon, Manifold, or Transfer Papers.

VULCANITE writes:—"With reference to the manufacture of carbon paper, I may say, in reply to CASENHEM that the material I use is common newspaper. I lay it on a hot plate and rub it with a cake of ink, removing surplus with a cloth. The cake of ink consists of 5 ozs. of lard, 1 oz. of beeswax, $\frac{1}{8}$ of an oz. of Canada balsam, melted together, lampblack is then stirred in till it is as thick as good cream. After mixing well, while hot, run into a mould, or leave to cool, it is then ready for use as above. This is written with it, and is the twenty-fourth page of my writing with the same paper." [VULCANITE's communication speaks well for the carbon paper that he makes according to his formula. The writing, which is brown-black in colour, is remarkably clear and well defined.—ED.]



ALTERNATIVE DESIGNS FOR FRETWORK PANELS FOR SCREEN.—ONE-SIXTH ACTUAL SIZE.

INFORMATION SUPPLIED.

Glass Eyes for Stuffed Animals.

E. W. writes:—"As an amateur taxidermist of eighteen years' standing, I shall be glad to give PRESERVER, or any other enquirer, the benefit of my experience, and for this purpose, enclose my card to the Editor. Artificial eyes are cheap enough, as supplied by Messrs. Pache and Son, 171, *Bristol Street, Birmingham*, and by Mr. H. W. Marsden, 37, *Midland Road, Gloucester*."

E. P. (*Midleton, Co. Cork*) replies to PRESERVER:—Mr. Pache, 171, *Bristol Street, Birmingham*, will supply catalogue on application.

Quick Drying Black Varnish.

W. E. (*Gipsy Hill*) writes in reply to A. B.:—"The following ingredients will make a quick drying black varnish: 1 pint of methylated spirits, 4 ozs. of white shellac, 1 oz. of sandarac, 5 ozs. of drop black (powdered), 5 ozs. of resin (powdered).

How to Clasp Broken China.

O. B. (*Jersey*) writes in reply to A RESIDENT IN THE HIGHLANDS, page 103, Vol. IV.:—"About the time your question appeared in Ours, I, too, was on the look out for instructions for riveting china, but until lately, have not been able to obtain any satisfactory information. I saw an advertisement in the 'English Mechanic' a week or two ago offering diamond-pointed drills for china and glass drilling for sale. I wrote for prices, and they were 2s. 6d. for drills drilling $\frac{1}{16}$ inch, and 4s. 6d. to drill $\frac{1}{8}$ inch holes. They may be obtained of Mr. C. Blanchard, 29, *Earl Street, Lisson Grove, London*, who will answer any questions on riveting that may be asked through the columns of this paper."

Division Plate.

Harr's Foot writes:—"In the following remarks on the method of making a lathe divider, I shall try to answer A. F. S. (*Dresden*), and give other amateurs who are interested in the matter a wrinkle on this subject, by aid of which they will be enabled to turn out first class hexagon, or other kinds of nuts and bolts, and may, moreover, do the work with a plain lathe—the one, for instance, sketched in Vol. I., p. 4—with the addition of a patent, or wire chuck. To make the divider, turn as many rings as you want on the inside of the headstock pulley, and if there is not enough of surface here, owing to the hollow turned out of some, you can fix a brass plate on, and turn the rings on it. Now divide these rings into parts, and drill a small hole, the use of which you shall presently see; that you are particular in having the holes the exact distance is absolutely necessary if you would succeed. Nothing succeeds like success, and this is only to be obtained by careful working at first. Having the divisions made, now we shall proceed and make the divider (Fig. 1) which is a blade, or strip of metal, with a small-pointed steel stud at the end. The blade, or divider,

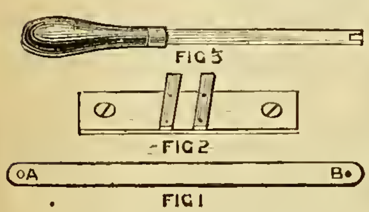


Fig. 1.—Dividers.—A, Hole for Pin; B, Stud Pin. Fig. 2.—Socket for fixing to Lathe and Slot for Divider. Fig. 3.—Guide Tool for Cutting Nuts.

works from the sole of the headstock, where it is fixed, so as to be raised when wanted, and laid down when not in use. The manner of fixing is with a somewhat bent-shaped socket (Fig. 2) made from a piece of brass about one and a half inch long, and half inch square. Make the divider from one-eighth inch sheet metal, about three-eighths inch broad, cut a slot in the centre of half inch brass to suit the divider; next, divide off about one-eighth inch on each side of the slot. You can now proceed to file the rest down, to provide a sole, to be fixed with two screws to the headstock. Put your divider into the socket thus made, and drill a hole through them; now round off the end of the divider, which will allow it to work freely. You will now have the divider complete, provided you have added the stud, ready for screwing on to the sole of the headstock. When fixed, you will have a perfect divider, as will be easily seen when the divider is raised to the ring turned in the side of the pulley, the stud will fall into the division holes itself. You will take care to have a slight spring against the pulley from the divider. To make nuts, chuck wire about the size you want, you could draw a point tool along the rest, marking the chucked wire at every division, this is a very good way to begin, but a little practice will enable you to guess your work without lines, file off to lines, and you will have the pin you want; face off the end and mark the centre with the graver, which will be a start for the drill, which, hold in a pair of small pin-vices, and bore up, chamfer, and cut off (a slotting file is about the best for the purpose as you get both face and back flat). I would advise the amateur to make a guide tool (Fig. 3) by means of which he could cut all alike. This is easily made out of small graver steel, filed flat at one end, and a hollow cut out, leaving two prongs, the inside only needs to be sharp, the other is better left a little longer, which is the prong that is placed against the face of the nut, the other cutting a mark, then cut off with the slotting file, but before cutting off, tap. Bolts may be made the same way. A better way is to file the part to be screwed, tap, then file the head to the pin required. This divider is useful for dividing anything in the lathe, but principally for the finely finished nuts and bolts of models."

INFORMATION SOUGHT.

Addresses of Timber Merchants in London, N.W.

F. T. (*Harrow*) wishes to know the address of a good timber dealer where woods of various kinds—oak, American pine, etc.,—can be obtained for *amateurs'* use. [I presume F. T. wishes to know where he can buy wood in the neighbourhood of Harrow, or the N.W. postal district. It would be useful if readers would send me addresses of timber merchants in all parts, town and country, for general use.—Ed.]

Stop Chamfer Plane.

Mathew Stickleback asks:—Has R. A. (*Carnarvon*), Vol. III., page 289, ever tried his "home-made" plane as a *stop chamfer* plane? It seems excellent for a plain chamfer, but as with a broad chamfer, the top of the V-space is cut off by the sole of the plane. I can't see how he can either cut the stop or get up to it, which the full V in Booth Brothers' plane allows of. How does he manage it?

Squeaking in American Organ.

Key writes:—"I have one of Carpenter's American organs, and when playing forte, one of the treble notes, a second or two after being pressed down, begins to squeak. Can anyone tell me the reason, and how to alter it?"

Mice Killing by Electricity.

J. T. B. (*Malmesbury*) asks:—Can anyone tell me if there is any arrangement for killing mice with a Leyden jar, or otherwise? I saw a notice of such a thing in "Cassell's Family Magazine" some time ago. [Then why not hunt up the information required in the magazine in which you say you saw it? Enclosed with the above query was a notice for sale or exchange of a clock movement for model boat, but as you only give your initials and the name of the town in which you reside, I have been unable to return it to you, and tell you that all such notices must be prepaid at the rate of 1d. for every four words—or fraction of four words, when the notice is over twelve words—as yours is. If you still wish to advertise the movement, send me another notice with the requisite number of stamps in prepayment.—Ed.]

Ornamentation with Moths' Wings.

Man Jack writes:—"I have about two or three hundred moths' wings, and I want to make an ornament of them. Can anyone give me a design for a decorative picture to be made of them, and tell me how to fasten them on?"

Toboggan Sledge.

A. F. M. (*St. Andrews, N.B.*) wishes for a description, with diagram in illustration, of a Toboggan Sledge. [I cannot give you what you ask for myself, and your application reached me too late for insertion in the December Part.—Ed.]

Celluloid for Organ Keys.

Joiner asks:—Will some reader kindly inform me where the above can be purchased, and at what cost? [Mr. Mark Wicks wishes me to say that he cannot answer this question, and would be glad himself to have the information sought for.—Ed.]

Tubular Die.

James writes:—"I should be glad to know how to make a die, so as to give a tubular form to plastic materials, pressed through, such as macaroni, for instance."

Magic Lantern Slides.

R. J. S. writes:—"I wish to make some magic lantern slides as economically as possible, suitable for amusing children, by some means, if possible, other than by painting on glass. I have tried ordinary transfer pictures gummed on glass slide, and coated with white paper varnish, but they are too opaque, and, besides, hardly good enough. Will some one kindly give me information on the subject?"

Squirrel Cage and Wheel.

Naturalist asks: — Will any reader kindly give me a design for making a pretty squirrel cage with wheel?

Synchronizer.

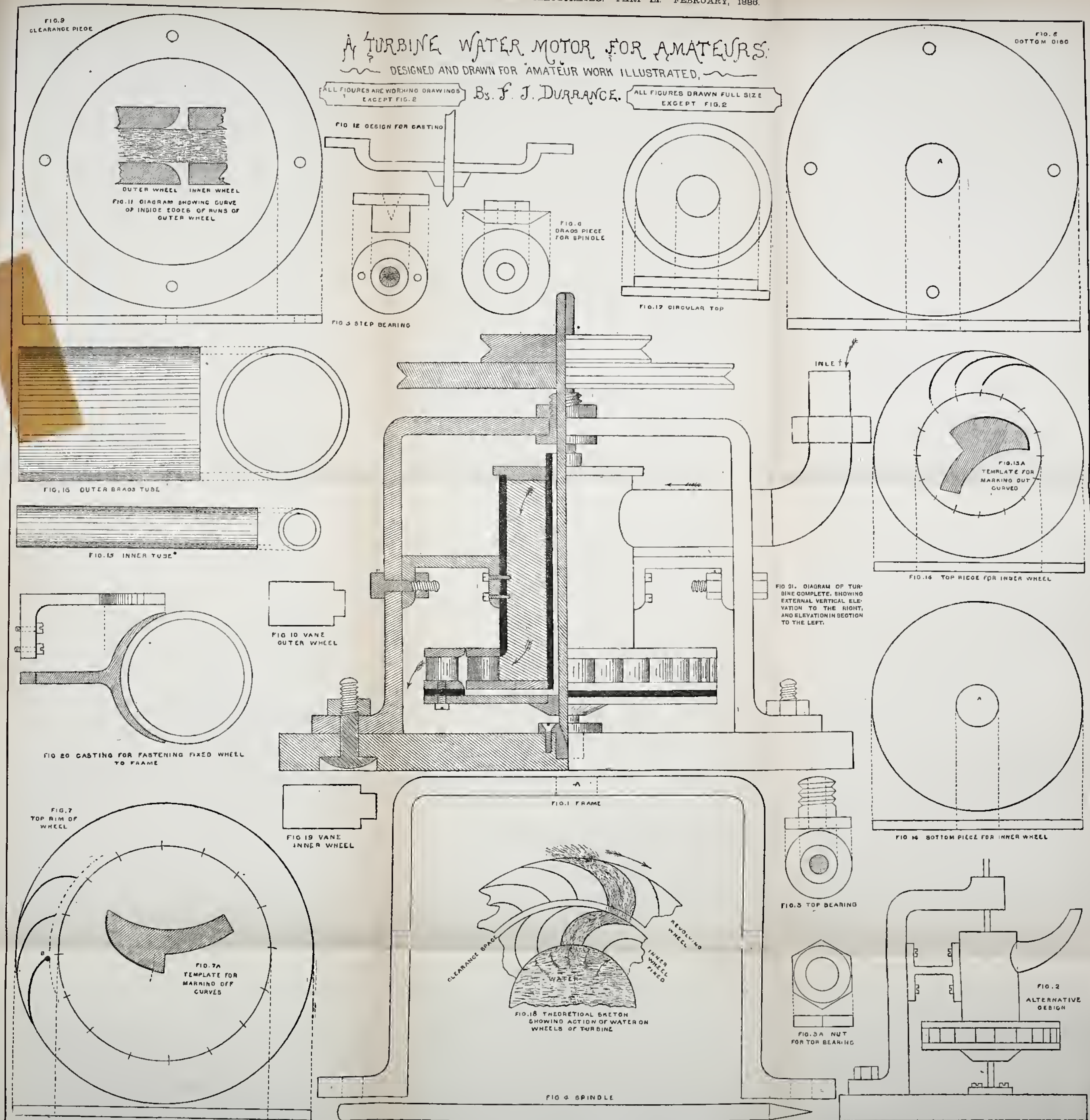
An Old Subscriber asks:—Will a reader kindly inform me how to make, or where to buy, a Synchronizer, for regulating clocks, as used with "Barraud and Lund's" clocks? I want to regulate three clocks in different parts of house by one standard clock.

Papier Mache Work.

W. H. R. wishes for some articles on Papier Maché Work. I may, perhaps, be permitted, as Editor, to add that I also wish for some papers on this subject, as I believe the preparation and moulding of paper for various purposes is fully within the power of amateur workers.

COMMUNICATIONS AWAITING REPLY

F. A. E. (*Bailieboro*); Nameless; Musjin; C. C. F.; Loco (*Sohagpur*); Messrs. Richards, Terry & Co.; Amateur Harmonium; An Old Relief Stamper; E. A. J. (*Dublin*); M. H. W. (*Manchester*); Man Jack; Savant; G. B. (*Cheltenham*); Old Subscriber; Micro; Engineer; W. H. T. (*Notts*); C. E. C.; Messrs. Stevens & Co.; F. T. (*Harrow*); I. R. O.; J. L. (*Weymouth*); D. G. T. (*Somerset*); E. S. D.; Lex; Lignum Vitæ; H. O. S. (*Tunbridge Wells*); Engineer; Varnish; Teleograph.


A TURBINE WATER MOTOR FOR AMATEURS.
DESIGNED AND DRAWN FOR AMATEUR WORK ILLUSTRATED,
ALL FIGURES ARE WORKING DRAWINGS EXCEPT FIG. 2
By. F. J. DURRANCE.
ALL FIGURES DRAWN FULL SIZE EXCEPT FIG. 2
FIG. 9 CLEARANCE PIECE
OUTER WHEEL
INNER WHEEL
FIG. 11 DIAGRAM SHOWING CURVE OF INSIDE EDGES OF RUNS OF OUTER WHEEL
FIG. 12 DESIGN FOR CASTING
FIG. 6 BRASS PIECE FOR SPINDLE
FIG. 3 STEP BEARING
FIG. 17 CIRCULAR TOP
FIG. 8 BOTTOM DISC
A
FIG. 16 OUTER BRASS TUBE
FIG. 15 INNER TUBE
INLET
FIG. 13A TEMPLATE FOR MARKING OUT CURVES
FIG. 14 TOP PIECE FOR INNER WHEEL
FIG. 10 VANE OUTER WHEEL
FIG. 21. DIAGRAM OF TURBINE COMPLETE, SHOWING EXTERNAL VERTICAL ELEVATION TO THE RIGHT, AND ELEVATION IN SECTION TO THE LEFT.
FIG. 20 CASTING FOR FASTENING FIXED WHEEL TO FRAME
FIG. 1 FRAME
FIG. 14 BOTTOM PIECE FOR INNER WHEEL
FIG. 7 TOP RIM OF WHEEL
FIG. 19 VANE INNER WHEEL
FIG. 5 TOP BEARING
FIG. 7A TEMPLATE FOR MARKING OFF CURVES
CLEARANCE SPACE
REVOLVING WHEEL
INNER WHEEL FIXED
WATER
FIG. 18 THEORETICAL SKETCH SHOWING ACTION OF WATER ON WHEELS OF TURBINE
FIG. 5A NUT FOR TOP BEARING
FIG. 2 ALTERNATIVE DESIGN
FIG. 4 SPINDLE

SOME HINTS ON CONJURING APPARATUS.

By D. B. ADAMSON.

I.—THE OBEDIENT BALL—PLATE AND HANDKERCHIEF.

THE Professor, *loquitur:*—"LADIES AND GENTLEMEN,—In my hands you will observe I hold a ball and a piece of string, which I pass to you for examination. Both were presented to me by my friend the King of the Cannibal Islands one evening as we were walking home arm-in-arm to the Royal Wigwam from an entertainment I had just given in his Majesty's private theatre. 'My dear professor,' said he, in accents of bibulous emotion, 'this ball demonstrates that the laws of gravitation, as propounded by our savants, are at fault, as the earth under certain circumstances loses its power of attraction; in other words, the ball possesses no weight, and does not fall to the ground as you know ordinary objects do when the holder of the string wills otherwise.' I could scarcely believe that his Majesty would impose on a simple man like myself, who always adheres to facts—the truth, the whole truth, and nothing but the truth, being *my* motto. I nevertheless expressed my incredulity, and delicately hinted that perversion of the truth was not unknown in the part of the world where we were. His Majesty, instead of being offended, kindly gave me further instructions, and advised me to put them to the test at an *early* opportunity. I asked him whether five o'clock a.m. would do. He said it would, but four o'clock would be earlier. This I could not gainsay, so before retiring for the night orders were given that I was to be wakened from my slumbers at that hour. To my intense disgust, at four a.m. these orders were faithfully carried out. Sleepily and yawningly, I got the string and ball, when, lo and behold! the ball stopped on the string at any point I commanded it to. Later on I discovered that its properties are not influenced by the time of day, or I should not be able this evening to show you the beautiful scientific experiment proving conclusively that the powers of gravitation, like those of animation, may be temporarily suspended. Did time permit, I could," etc., etc.

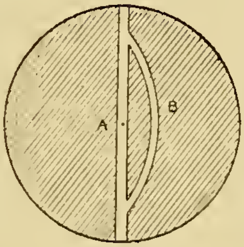


FIG. 3.—BALL IN MID-SECTION.

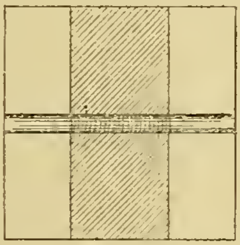


FIG. 1. — FORMATION OF BLOCK AND STRAIGHT CENTRAL GROOVE.

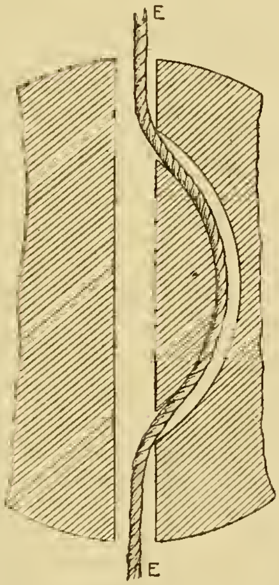


FIG. 4.—ACTION OF ROPE.

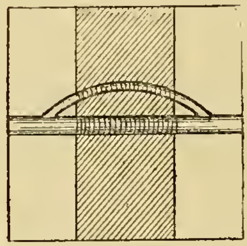


FIG. 2.—MODE OF MAKING CURVED GROOVE IN BLOCK.

While the professor has been talking you have examined the ball and string. The former is wooden, about 5 inches more or less in diameter, painted or japanned black with some rudely-executed hieroglyphics adorning (?) its surface. Six of the characters on it look suspiciously like H,U,M,B,U,G. Right through the ball a hole about ½ inch wide is bored. This is clearly wider than the string, which looks uncommonly like a piece of ordinary blind cord. Having handed the things back to the professor, who is all the time talking with "twenty woman power," he runs the string through the hole in the ball. One end he puts under his foot, and the other he holds in his hand in such a way that the string is taut and perpendicular. He raises the ball with the other hand to the top of the cord, down which it slides or falls to the ground when released. This he does two or three times to convince the sceptical that there is no deception, but that the ball will fall, as any right-minded one would in the same circumstances. He now announces that he will order the ball to descend slowly and stop at any given point. He is as good as his word, and the ball proves itself obedient in every case, descending fast or slowly and stopping when told. He invites any of the audience to try it, assuring them that they can do it as well as he, if possessed of a sufficient amount of will-power. You would like to try? Very well, walk up. You take the ball, thread it on the cord, and hold it just as you saw the professor do. You then order the ball to stop half-way down, and let it go, when—crash, down it falls on your favourite corn. Professor sympathises, asks you if you exercised your will sufficiently—can't make out the cause of the mishap, as you assure him you did—but finally concludes and explains that you must have *put the string wrong end first through the hole.* You have an idea that he is

laughing in his sleeve, and you are not far wrong. The following explanation will enable you to make a ball quite as obedient as that which was alleged to have once belonged to the professor's royal friend. How the professor's imagination does carry him away sometimes! He had the identical ball made thus:—

He got two pieces of nice clean pine, each measuring about 5 inches square by 2½ inches thick. In the direction of the grain he cut in each a groove ½ inch wide by ¼ inch deep, dividing the surface into two equal parts (Fig. 1). In addition, in one piece he cut a groove, as shown in Fig. 2. The two pieces were then glued together, forming a 5-inch square block with a hole through it. This block was next turned into a ball, then blackened and varnished. It was afterwards roughly ornamented with a little of Judson's gold paint or something similar, and it was complete. Fig. 3 will show how it is rendered obedient to the performer's will. The string, though apparently put through the straight hole, A, is really threaded through the curved one, B. While the string is held as already described, but not quite taut, the ball will descend quickly or slowly according to the tightness of the string. To stop the ball instantly it is only necessary to pull the string tight. Fig. 4 clearly shows its action, and of course, it will be seen that it does not in the least matter from which end the cord is put in. In handing you the ball and cord, they were apart, and you simply put the cord through the straight round hole, not noticing the other, or if you did mistaking it for a flaw in the wood, as it was the maker's intention you should. It is well not to have the curved groove too large, nor the ends of it too near those of the straight one, but as close observation will show that it exists, make it look as much like an accident of construction as you can. The grooves should be blackened, or at least the straight one and the mouths of the other. As the string is obviously smaller than the hole through which it apparently runs it would never do for the performer to be fumbling and searching for the side groove when threading, but unless he has something outside the ball to indicate where it lies he is very apt to do so. He should therefore place a mark of some sort, such as a small scratch, on the varnish, close to the ends of the hole on the side where the curved groove is. (See E, E, Fig. 4.) Of course, the size given is not absolute, as the ball may be of any dimensions, but if very small it should be of sufficiently heavy material to descend readily and overcome the friction of the string and the wood. Nor is it necessary that the block should be spherical in form, as a hexagonal, octagonal, conical, or any other shape may be made, the principle being the same inside. A very handsome "obedient ball" may be made by using different coloured pieces of wood in layers, as indicated in Figs. 1 and 2, and finishing it by polishing. Silken or other fancy cord may also be used if preferred, to improve the appearance of the trick.

Handkerchief and Plate Trick.

The professor continues—"During a long course of scientific investigation carried on in pursuit of my art, I have, as you may suppose, made some surprising discoveries. I propose now to show you one which is not the least remarkable of these.

"It is needless to weary you by relating in detail the many failures that occurred between the first conception and the final realization of my hopes and aspirations. Suffice it to say that after many months of ceaseless labour I found that I had at last conquered a difficulty hitherto deemed unsurmountable —I had solved the problem of the invisible passage of matter through matter. You doubt it, possibly, but I hope by the time I have concluded the experiment to have carried conviction to your minds.

"In order to prevent any suspicion—some people are *so* suspicious!—that I use prepared apparatus, as conjurors who are unacquainted with the higher branches of prestidigitation perhaps do, I will borrow a plate—an ordinary soup plate will do. Thank you—yes, that will do very nicely. Kindly pass it round along with this handherchief for examination. Well, as you have all examined these things I will now ask your closest attention to what I do. Unless you observe me very carefully, although I may say this is not an instance of the quickness of the hand deceiving the eye, you will not be able to repeat the experiment. If, however, you do observe me carefully, why, then —the result will probably be the same.

"I take the plate and put it upside down on this table, where you can all see it; I now take the handkerchief which you have just examined in my two hands and compress it into as small a bulk as possible. If your eyes are good you will note that it is getting smaller by degrees and beautifully less. It is now so small that I hold it under the tip of one of my fingers. With a powerful microscope you might still be able to discern it, although it is in its present state no more tangible than a 'kerchief of the mind, a false creation proceeding from the heat-oppressed brain.' I therefore throw it at the plate, and as that great and good man, Macbeth, King of Scotland, might have said, had a certain lethal instrument disappeared when he addressed it, 'I have thee not, nor do I see thee still.' If some one will be good enough to lift the plate I have no doubt the handkerchief will be found under it. Yes, there it is!" So saying, the professor retired, and, as he surmised, you are no wiser than before as to how the trick was done.

Of course, the professor's assertion that he had

made no preparations for its performance must be taken with a due allowance for his well-known powers of romancing. He had thoughtfully provided himself with two small handkerchiefs of crimson sarsanet exactly alike. One of them, folded up into a small compass, he had placed beneath and near the edge of his waistcoat on the left-hand side, just below or slightly to the left of the pocket. It was kept in place and out of sight by the waistcoat having a strip of elastic band stitched to the inner edge of it. This kept the lower edge of the waistcoat tight. The other handkerchief he kept in its usual pocket, whence it was produced before being handed round.

On the middle of the back of his unmentionables, about in a line with the bottom of the waistcoat, was stitched a good-sized eye, or small, smooth ring. Through this was passed a piece of thread or tape elastic, one end of which was formed into a loop. This loop was brought to his right side, and fastened to a hook fixed near the top of the side seam of the trousers, or slipped on to the button which is usually found thereabouts.

The other end of the elastic was attached to a small black cup-like receptacle, made as follows: Cut off the blunt end of an egg neatly—not too far down, but so that the diameter of the top shall be a little less than the diameter of the shell at its widest part. The contents being removed, glue strips of calico over the shell, inside and outside, as well as over its edge. Put on several layers one over the other, and when all are dry a strong tough cup will be made. The calico should be blackened. Ink will do for this very well. The elastic can be put through a hole in the bottom, and knotted securely inside.

This prepared egg-shell was put under the waistcoat on the right-hand side in the same way that the handkerchief was on the left. The elastic was of such length that, though somewhat stretched by passing from the button through the eye at the back and forward again to the cup, it still allowed of this being brought forward some few inches, when it should be at its full tension.

Before taking up the plate after it had been handed back to him, the professor caught hold of his waistcoat with the left hand as if to pull it down. The movement being perfectly natural you thought nothing of it—in fact, did not notice it at all, but it allowed of the handkerchief being withdrawn. Immediately, taking the plate in the same hand and holding it upside down, there was no fear of the handkerchief being seen, especially as only the bottom, not the inside of the plate was seen. The thumb was on the bottom, the four fingers in the inside of the plate, holding the handkerchief between it and them. On laying the plate down care was taken that the hand should be on the side furthest from the audience. The hand was removed, but the handkerchief was left under the plate, of course its presence there being unknown and unsuspected by spectators.

The other handkerchief, which had been in full view of all, was now taken in the left hand, the performer's left side being turned to the audience. At the same time, with his right hand, he ostensibly pulls his waistcoat down, but, in reality, seizes the cup and brings it a little forward.

The cup must not be visible to spectators, hence, as quickly as possible without being unduly hasty, the right and left hands are brought together, and the handkerchief slowly pressed into the cup, the mouth of which is away from the performer, who during this part of the performance still keeps his left side to the audience. The handkerchief being at last entirely in the cup, the performer releases it, when the elastic at once pulls it back under his coat.

The appearance of further compressing the handkerchief should, however, still be kept up, till it is presumed to be so small that it is covered in the palm of the right hand by the fingers of the left. Remove the fingers one by one till it is supposed to be rolled up under the tip of the last remaining finger touching the right hand. A motion as of throwing may then be made, and on lifting the plate the handkerchief, apparently the one that was examined, will, to the astonishment of all not in the secret, be found underneath. The elastic should be of good quality to allow of it being stretched well, and, if doubled, the chance of a mishap through breakage is diminished.

This trick, like all others, should be practised in private till it can be performed without awkwardness. Before the cup is released, the hands must be kept near the body, as the elastic will not stretch very far; afterwards, during the imaginary compressing of the handkerchief, the arms may be extended gradually; and if the coat sleeves are turned up the appearance of the trick will be improved.

(*To be continued.*)

HOW TO PACK PICTURES FOR TRANSIT.

By H. C. STANDAGE.

I.—SINGLE PICTURE, WITH FRAME, IN CASE—PICTURE AND FRAME PACKED SEPARATELY.

PACKING pictures for travelling is no easy matter, even by experienced hands, for, should a screw or rivet get loose, a wedge fall out, or the glass break, a picture worth, perhaps, hundreds of pounds, may be irretrievably damaged; the owner, therefore, should not entrust its packing to some village car-

penter; he should superintend the packing, or far better, pack them himself. Of course, it is not alone careful handling that the pictures require; there are many more serious points to consider than the mere one of being careful not to knock a hole through the canvas. As most readers will not know how to pack pictures correctly, and as many may desire to know how to do so for removal, I have thought it worth while to give precise directions for packing cases containing one or more pictures.

Let us commence with one picture in a frame, which is also to be packed with the picture.

There will be two ways in which this can be done: either by separating picture and frame, fastening them to the case singly, or else by packing picture and frame as if only one article. We take the latter case first. The first thing to do is to select corner and lid sufficient to prevent the canvas being pressed on. There is another point to be considered; it is, whether the "stretching-frame" in which the canvas is tacked projects beyond the back of the frame or not. Should it do so, this extra projection must be allowed for in gauging the depth of the case necessary; thus, if the stretching-frame projects 1 inch beyond the picture frame (see A, Fig. 1), $1\frac{1}{4}$ inches must be allowed. This extra $\frac{1}{4}$ inch is necessary, because the battens that will have to be screwed to the frame before it can be screwed to the packing-case must be more than 1 inch thick. The reason is this: should any pressure be exerted against this stretching-frame, it is as likely as not to break away the rebate in front. The writer has met with pictures thus packed, where the stretching-frame has almost come out of its place in front, owing to the gold

FIG. 1.—END VIEW OF FRAME.

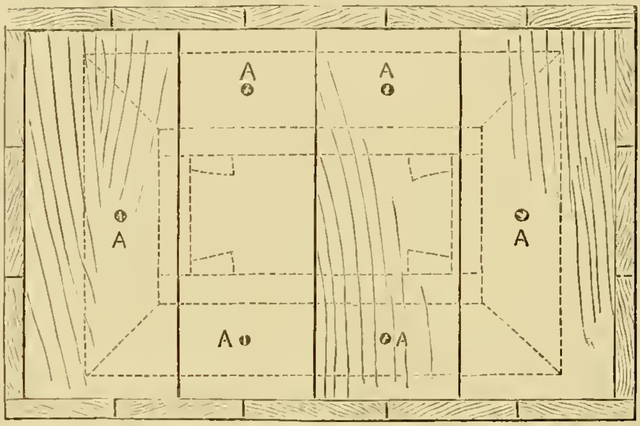


FIG. 3.—BACK OF CASE.—Position of Picture in Case shown by Dotted Lines. A, A, are Screws holding Picture to Back.

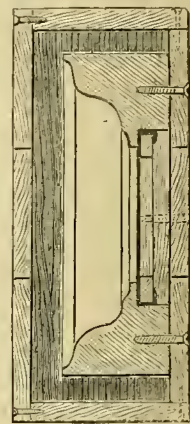


FIG. 2.—SECTION OF FRAME AND CASE.

a packing-case deep enough to hold the frame and allow a half-inch space at least between it and the lid of the case. Supposing the frame is 4 inches thick and has "compo" ornaments that project 1 inch, the depth between the inner surface of the lid (when screwed down) and the inner surface of the bottom of the packing-case, should be at least $5\frac{1}{2}$ inches; and should the lid be made of thin wood, this "depth" should be 6 or more inches, as, otherwise, depression of the lid by other packing-cases being stowed on top of it in transit might cause the lid to "belly" (*i.e.*, sink by the superimposed weight), and so much so, that it might press on the "compo" corners and break them. The mere breaking of these corners would not be the only damage; the pieces of hard "compo," when broken off, would undoubtedly do damage to the painting as the case was turned over by the carrier or railway porters. Measure, therefore, the depth of frame to edge of its back (see arrow, Fig. 1), and allow a space as in Fig. 2, between the rebate or "sight" having been broken away all round, due to pressure on the back of the picture. If the stretching-frame projects but a trifle—$\frac{1}{4}$ inch or less—four or six pieces of cork should be nailed round the back of the picture frame at regular intervals. These pieces of cork should be twice as thick as the projection is deep. These pieces of cork act as a buffer, and allow the screws to be screwed "home," and so hold the picture-frame close to the packing-case. There is still another point to be considered in the preliminaries, and this is the packing of a glazed picture. If the glass is fixed in the frame—that is, the glass is not fitted to a "door" which is then held in the frame by bolts or locks—it should be pasted all over with strong brown paper, so that, should it be cracked by any means, no small pieces of glass will become detached and get loose in the case. The pasted paper prevents in a great measure the jarring of the glass.

Having attended to these preliminary points, tack

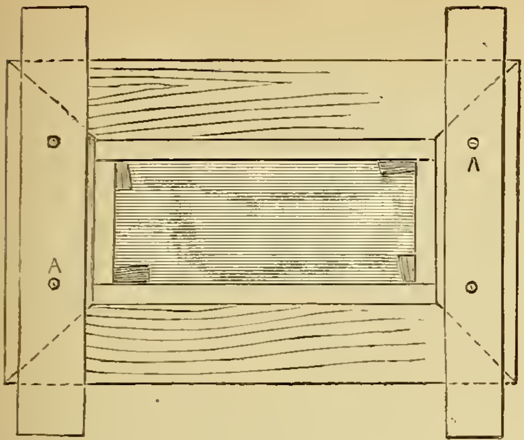


FIG. 4.—PICTURE LONGER THAN EXTREME WIDTH OF BATTENS.

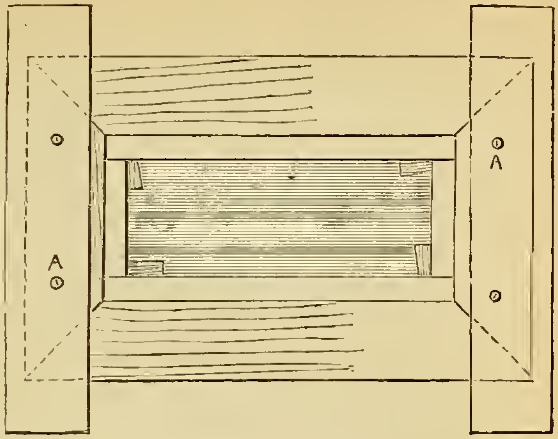


FIG. 5.—PICTURE SHORTER THAN EXTREME WIDTH OF BATTENS.

some waterproof brown paper, or, at all events, stiff brown paper, all over the inside of the packing-case, and then proceed to screw in the picture and frame.

Fig. 3 represents the back of the case, and the dotted lines represent the picture and frame when screwed to the back of the packing-case; A, A, A, A, A, A, shows where the screws should be placed. Never put them too near the mitres (*i.e.*, the joints at the corners), or otherwise, when screwing up tight, the mitres might be "started"—*i.e.*, cracked or open at the joints.

While the picture-frame is being secured to the back of the packing-case, a second person should hold the frame, and hold it firm, while the screws are being put in. The frame should be square with the case—that is, there should be an equal space all round between the frame and sides of the packing-case; an inch is sufficient space to allow. To put in the screws, the case must be rested on one end, and consequently the frame should rest on two blocks of wood an inch thick, so as to secure this inch space on that side. These blocks should be removed when all the screws are driven home.

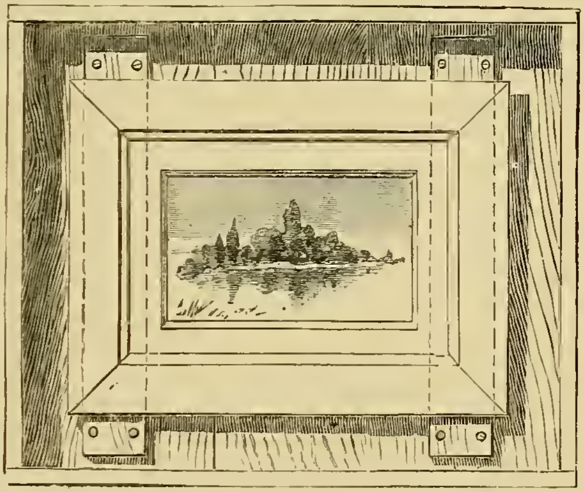


FIG. 6.—BATTENS CARRYING PICTURE SCREWED TO CASE.

The person who puts in the screws must be careful not to screw them up too tight, as otherwise any sudden

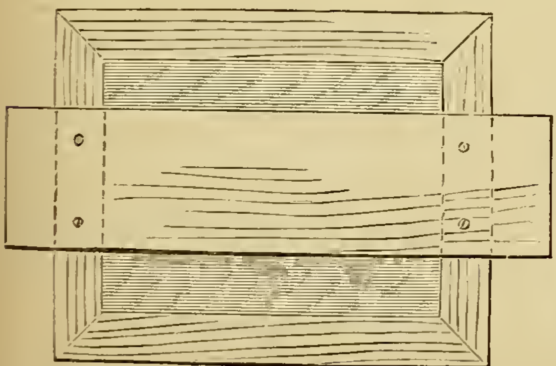


FIG. 8.—FRAME SECURED TO SINGLE BROAD BATTEN.

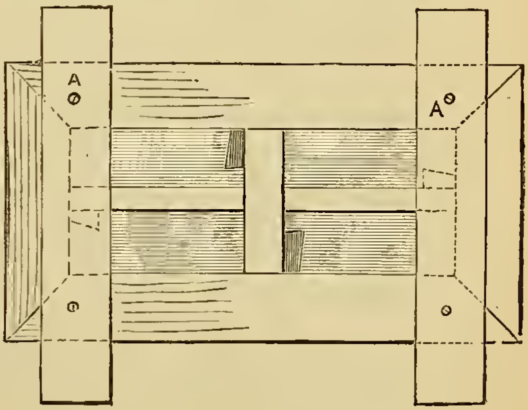


FIG. 7.—BATTENS SECURED TO STRETCHING FRAME OF PICTURE.

jar or shaking the case may experience will be communicated to the frame, with the possibility of shaking off some of its ornamentation or otherwise damaging it. To prevent this, the person holding the frame should keep just the tips of his fingers between the frame and packing-case, and when he feels them being pinched he will know that the frame is screwed tight enough to the case. A picture can be safely packed in the above manner when the stretching-frame does not project; should it do so, an entirely different mode must be adopted, for the frame cannot be screwed directly on to the inside of the case, but must be attached by means of battens—*i.e.*, strips of wood secured to the picture-frame. In this the mode of packing is as follows :—

Lay a piece of thick baize (or a linen sheet folded several times) on the floor, then lay the picture and frame face downwards on this, tighten up the canvas by gently, but firmly, tapping the wedges with a hammer; do not use more force than necessary in this, but drive the wedges home thoroughly tight, so that they shall not shift or become loose by any straining or shaking the stretching-frame may undergo. Select the pieces of wood for battens, particular attention being paid to the greater thickness of the battens than the amount of projection of the stretching-frame. About 3 inches in breadth will be sufficient for them; but their breadth will greatly depend on the width of the picture-frame at the back. The mode in which they are secured to the frame will also depend on the width of the picture-frame, for on no account should the latter press on the stretching-frame anywhere.

Say the width of the picture-frame is 4 inches, and the battens 3 inches (their position is shown in Fig. 4), 2 inches will be sufficient for the ends of the battens to project along the edges of the picture-frame; and it is better for the battens to be a trifle shorter than the inside measurement of the case, so as to allow a little "play" between the ends of them and the sides of the packing-case. The position of the screws is a point for careful consideration; first, it is better to screw them into two only of the four sides of the frame, because the sides of the frame are not held too rigidly together; secondly, the thickness and shape of the moulding of which the frame is made must be considered, because, if the moulding is concave, the screws must enter into the thick part of it, so as not to pierce through the gilding. The length of the screw must also be carefully calculated. If the picture is not very heavy (fifteen to twenty pounds in weight), $\frac{3}{8}$ inch for each screw to enter the frame will be quite sufficient. Then suppose the batten is 1 inch thick, a $1\frac{1}{4}$ inch screw will be quite long enough when driven home tight, especially if they are Nettlefold's well-threaded screws. In heavier pictures (of course, canvas and frame is here included), $\frac{1}{2}$ inch to $\frac{5}{8}$ inch will be found quite sufficient for the screws to pierce the frame. Two screws in each batten will be sufficient for a frame of 3 feet breadth and under; over 3 feet, three screws should be used.

In the case of the width of the picture-frame being less than the width of the batten, Fig. 5 shows the arrangement to be made. A batten should not be less than $\frac{1}{2}$ inch thick, nor less than 2 inches wide.

Having secured the battens to the frame as directed, the next step is to fix the picture into the case. To do this, lay the case down, having taken care to paper it inside, as before directed; brush out all dust, and be careful that there are no loose chips of wood, nails, etc., left in it; then lift the picture carefully into the case, keeping the face uppermost, that is the battens rest only on the case. Arrange the picture square with the inside of the packing-case, and then screw the battens to the back of it; but, in the previous example the screwing had to be done from the outside of the case; in the present example the screws enter first through the battens into the back of the packing-case.

Two screws in the end of each batten is preferable to one, because the jolting the case may receive in transit is apt to loosen the hold of the screw; and should it become at all loose, the leverage thus obtained at one corner (*i.e.*, end of one batten becoming loose) acts very powerfully in loosening the other screws. Fig. 6 shows the picture in the packing-case, and the position of screwing down the battens.

If the picture rings have to be sent with the frame, it is best to take them out of the frame and screw them into the side of the packing-case; and to prevent the ring from flapping about, partly knock in a nail, and then bend it over the picture ring, so as to keep the latter steady.

We have now to consider the case of a picture and frame being packed separately.

In this case, lay the stretching-frame on an even surface, covered with a soft padding of baize or other cloth, and lay the picture face downwards on this; then fasten two battens to the stretching-frame, as shown in Fig. 7. Take care to place the battens so that they overlap the mitres or butt joints of the stretching-frame, taking care that they do not press on, or force out, any wedges. Use only one screw in the end of each batten, and be careful that this is not long enough to go through the woodwork of the stretching-frame into the painted canvas.

The picture-frame is best secured by means of one broad batten placed lengthwise of the frame (as shown in Fig. 8), because, since the frame has no longer the

support of the stretching-frame to enable the mitres to resist shocks or strains, they are apt to "start" or open if all four sides of the frame are secured by screws.

If, however, the frame is very heavy, and also strong, the arrangement shown in Fig. 4 will answer; and in the case of very well made and strong frames, it can be screwed to the case without the intervention of a batten, one screw being placed in the middle of each side of the frame, the screw entering from the outside of the packing-case.

(*To be continued.*)

GLASS PAINTING AND DECORATIVE GLAZING.

By L. L. STOKES.

II.—WORKING IN STAINED GLASS—CUTTING-OUT—MATTING—FIXING ON THE EASEL—PAINTING IN TRACING COLOUR.

WORKING IN STAINED GLASS.—As being the most important and interesting department of our subject, it will be with the processes of stained glass work that we must first deal. And before entering upon an actual first lesson, it will be well to gain a knowledge of the various stages through which the work will have to be carried.

Let us suppose that we are about to fill a small square window—one on a staircase, possibly. We fix on the design shown in Fig. 3—a friend humorously names it "Half a Page from the 'History of the Wars of the Roses.'" Our first business is to make a small coloured sketch in which we decide on our arrangement of colour, for well-arranged colour is in stained glass work a most essential point. This being done to our satisfaction, we next proceed to draw out a "cartoon," a drawing, that is, in which the proposed work is shown in its full dimensions. In this cartoon every separate piece of glass which is to be used must be shown, and the leads between the pieces indicated by bold black lines, which lines are usually made $\frac{1}{4}$ inch wide, or equal to the width of the lead; a stick of charcoal is best adapted for drawing these lines speedily. In doing this, especially in dealing with figure subjects, there is room for the exercise of much judgment, for it is the art of a good designer so to arrange his lead-lines, that instead of being unsightly, they shall add to the artistic effect of his finished work. Fig. 4 (which is not, however, drawn specially to illustrate this point) will show how many different pieces of glass go to make up the figure of the page.

Another technical point to be kept in view at this stage of the work, is that every piece of glass must be of such a shape that it can be cut out without breakage, a point with which we must deal more fully when we come to cutting out. Our cartoon when drawn in black and white may also be coloured. This will be useful as showing the full effect of the design, and will be of some assistance in cutting out the glass. The small coloured sketch is, however, generally held to be sufficient for this purpose.

From the cartoon, the lead-lines only are now traced off about one-eighth of an inch wide on a sheet of paper. Fig. 5 shows a portion of the lead-line cartoon required for the subject in hand. The reason for making the lines about one-eighth of an inch wide, being that this is about equal to the thickness of the "core" of the lead, viz., that part of it which comes between the pieces of glass. This paper is then laid on the glazing board. Fig. 6 gives a portion of a convenient form of glazing board, and shows its arrangement for fixing down the lead-line cartoon. The pieces A and B, which are movable, are unscrewed, and the cartoon is laid down so that these pieces, when re-screwed, shall bite upon and hold it firmly. The various sheets of coloured glass are then laid one at a time over the spaces which are to be filled from them. The lines on the paper will show through the glass, and the operator takes his diamond and cuts along the inner edge of the black lead-line, and so goes on with piece after piece till the whole design is cut out.

Cutting-Out.—The above words "cutting out" are easily said, but, especially by an amateur unpractised in cutting glass, the operation is by no means so easily executed. Men are no more born glaziers than they are born fiddlers, and the glazier's diamond is apt to perplex a beginner. At first he is more likely to scratch than to cut the glass. The proper method of using this tool is shown in Fig. 7. As there seen, it is to be held between the middle and fore fingers, and supported beneath by the thumb. The exact slant at which the diamond must be held varies in different instruments with the "set" of the stone. The beginner is strongly recommended to give himself some little practice on waste pieces of common glass before venturing on any actual work.

But the cutting of those straight lines, which are all that a glazier in dealing with ordinary windows has commonly to do, is an exceedingly simple matter, as compared with what has to be done by the cutter of stained glass. Granting that the designer has exercised so much care as to have avoided introducing any pieces which it is impossible, or next to impossible, to cut without breaking, there will still be to the beginner curves and angles full of dangers and difficulties. It may in a general way be said that all straight lines,

convex curves, and projecting angles, are easy and simple; that concave curves are difficult, and that they become exceedingly so when they represent the segments of very small circles; and that angles running into the glass involve so much difficulty in cutting as to be practically impossible. These observations the worker will do well to bear in mind when he is drawing his design that he may manage his lead-lines accordingly.

In cutting difficult forms more or fewer breakages will always occur, and with the beginner they will probably be more rather than fewer; but disappointments of this nature he must be prepared to put up with. In Fig. 8 is shown a difficult curve, and, indeed, one which it would be impossible to cut at a single operation, but still one to be successfully accomplished by patience. As shown in the illustration, the superfluous glass may be removed by cutting a series of easy curves, which are drawn one at a time with the diamond, and the section of glass so marked out is afterwards carefully nibbled away in small pieces with the pliers. This process of cutting and nibbling is repeated with the utmost care until the required curve has been hollowed out. Fig. 9 shows an inward angle, and a form so difficult to cut, that the designer ought always to avoid it. In a general way such a form may be regarded as practically impossible. Yet it is not absolutely impossible; and if there is a strong necessity for using such a shape, time and patience may achieve it. A hole may be drilled at this angle, the drill being wetted with turpentine to make it bite the glass; and the file may be called into use, the file being made to bite in the same manner. The pieces of glass being all cut out, they should be well cleaned with quicklime and water. They will then be ready for the next operation.

FIG. 3.—SUBJECT FOR LINING ON COLOURED GLASS.

Matting.—This consists in giving to the pieces of glass to be painted a uniform coating of thin matting or tracing colour, the composition of which has been described above. This colour is ground fine with a weak solution of gum arabic. The mat is brushed over the glass, and worked to an even and equal surface with the broad flat brush till it begins to dry. It is essential that it should be laid regularly. In

FIG. 5.—PORTION OF LEAD-LINE CARTOON.

FIG. 4.—METHOD OF FIXING GLASS TO EASEL.

painting on stained glass the "mat" may be said to serve for half-tones, lights being formed by scrubbing or scraping it away, and shadows by hatching or cross-hatching upon it. It is specially to be observed that the gum water used in mixing the colour for this purpose must be very weak, only just strong enough not to allow the mat to wipe off in dust with a slight touch; too great a proportion of gum would be liable to cause the mat to crack.

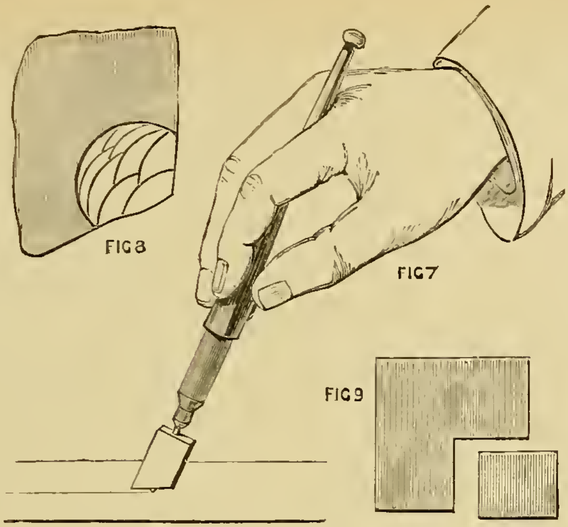


FIG. 7.—DIAGRAM SHOWING MODE OF HOLDING GLAZIER'S DIAMOND. FIG. 8.—A DIFFICULT FORM TO CUT. FIG. 9.—A FORM TO BE AVOIDED.

To mat, as above described, is the usual practice among professional glass painters: it facilitates the labours of a skilled hand. Yet it is not absolutely essential, and good work has been, and may be, produced without it. To the beginner it offers difficulties. He will find it no easy matter to lay the mat equally; any little accident is liable to damage it, and when he comes to lining upon it, he will find if he happens to make a false line that he cannot wipe it out without disturbing the mat. It is probable, therefore, that the novice may do well to avoid matting in his first works; but to this subject we shall return later on.

Fixing on the Easel.—The front of the transparent easel, Fig. 2, is, it will be remembered, formed of a movable sheet of clear white glass. This glass is now laid upon the cartoon, and the operator taking a camel-hair pencil, and some rather stiff Indian ink, proceeds to trace upon it not only all the lead-lines of the design, but also *all* the other actual lines. The use of these lines on the easel-glass will be apparent as we proceed, and they can easily be cleaned away when their immediate purpose has been served. In preference, however, to Indian ink, some artists use Brunswick black, as there is much less difficulty in drawing lines on glass with this paint, while with any water colour considerable trouble will be experienced. Brunswick black, too, cleans off readily with turpentine.

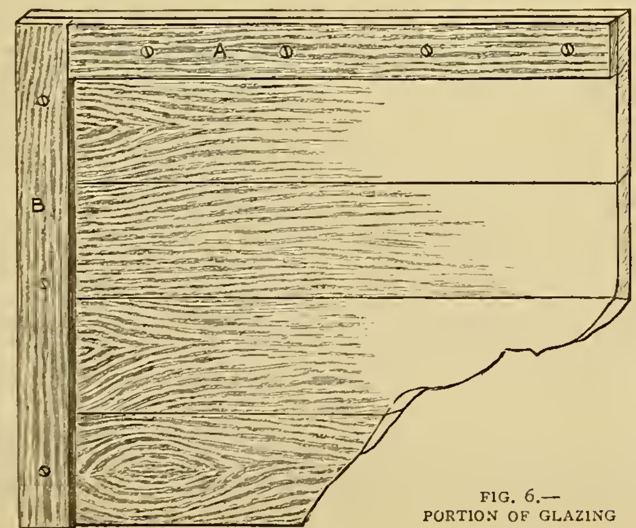


FIG. 6.—PORTION OF GLAZING BOARD.

The easel being thus prepared, the various pieces of glass which make up the design have to be fixed in their places upon it. This is commonly done with a composition known as wax, which is made of pitch, beeswax, and resin, in equal proportions. These are best melted together in an earthen pipkin, and some care must be taken whilst they are upon the fire, since if they ignite they will not easily be extinguished. Little button-like spots of this cement are to be dropped whilst it is still hot along the lead-lines (as is shown in Fig. 3), and the glass pressed down upon them, when it will adhere, or ought to adhere, firmly.

This is the usual method of fixing among our English glass painters, but it is far from perfect. The wax will sometimes give way with the warmth of the room, and a piece of glass slip from its place, often loosening others in its fall, and causing much mischief. For this reason some persons (the writer may be included in their number) prefer to fix the pieces together with leads in a temporary manner. This is said to be the practice of some continental schools of glass painting, and especially of the famous one at Munich. Beyond the additional security gained, this plan has the advantage of giving the worker more of the actual appearance of his window when finished, and of thus enabling him to work with more certainty of his effect. Its disadvantages are that it takes more

time, and involves some waste of lead; the latter is, however, no serious consideration, as scrap lead can always be sold at its market value.

Painting in Tracing Colour.—For painting, the easel should be placed before a light but not a sunny window, for it is not from the light reflected from his work that the operator sees it, as in ordinary painting, but from that transmitted through it. Beside the easel should be placed the cartoon, in such a position that the operator can readily refer to it as occasion may require. The colour to be used at present is merely tracing-colour ground up with so much medium only as will serve to attach it to the glass. So much must not be put as will cause the colour to shell up in flakes before the finger-nail. Some persons use treacle as a medium, some gum, some gum with a tenth part of glycerine added. The proper way of mixing for lining (the work we have next in hand) is to add the dissolved gum to the powdered colour, one drop at a time, till the mass is coagulated, and then to add water, one drop at a time also, till the mass is of the consistency of treacle, and will drop very slowly from the palette-knife. For washes, more water has to be added, but still one drop only at a time.

With the tracing-colour thus mixed, the operator traces over the various lines of the design, using for the work such a brush as that given at C, Fig. 1. This work is very simple, seeing that he has, as above mentioned, all these lines before him on the easel-glass, and has merely to run his liner over them. His chief difficulty at first will be, that with the opaque Indian ink lines beneath, he may not see whether his own lines have their due regularity and weight, and the tyro might derive benefit from a little preliminary practice in lining on a plain sheet of glass with no lines behind.

It is to be remarked that all lines should be drawn in strongly and boldly, since in the finished work they will certainly appear much fainter than they do at the time of drawing.

We are supposing that the work before us has been matted, so that in putting in the lights and shadows, which has next to be done, the operator can avail himself of the mat. The lights are obtained by scrubbing it away, wherever desired with the hard hog-hair brushes (B, Fig. 1). The shadows are made by cross-hatching upon it, where required, with tracing-colour, and these may be further deepened by washes of tar-spirit colour, described later on. In doing this, some care is necessary lest the mat should be disturbed.

To fix the colour more firmly to the glass it is now well to go over the whole surface with a clean, soft brush, dipped in spirits of tar. When this has dried, the work is looked over and touched-up where necessary. High lights are now obtained by scraping away the entire mat with a boxwood point, and lines and shadows deepened with more tracing-colour. This colour should, however, for this purpose be mixed instead of with gum water, or the like, with tar-spirit, or what is better, if you can get it, with old fat turpentine, such as is to be found in the dregs of a village huckster's turpentine can, or such as china painters prepare by putting turps in a wide-necked bottle, covering the opening with bladder pricked with holes, and exposing the vessel to the sun for some months.

The reason for thus washing over with tar-spirit, and subsequently painting with colour mixed with that or some kindred medium, is that the previous work may not be washed up and injured, as it would be by a medium of its own nature. After this, if necessary, more gum-water colour may be laid on, and the mediums may be thus alternated, and additional work laid on to any number of times in reason.

(*To be continued.*)

THE REFLECTING TELESCOPE:

ITS CONSTRUCTION AND MANUFACTURE.

By EDWARD A. FRANCIS.

IV.—THE SPECULUM GRINDER'S WORKSHOP (*continued*).

"IT is necessary to have lying by one an ordinary piece of coarse glass ground on the convex tool, called a bruiser." This instruction was written in a book now one hundred and fifty-nine years old, but we shall still require to obey it. The art of speculum working was then in its infancy, being in the tender care of some of those amateurs whose names were recorded in a previous paper. Fourteen years after, in 1742, we are told that Mr. James Short (before mentioned) made for Lord Spencer a grand twelve-foot telescope, and later still another for His Majesty the King of Spain, receiving for the latter £1200. This he did without any exact method of testing to throw light upon the working of that art, which in a more enlightened age we humbly seek to follow. Let us honour those old workers, that with the means at their hands they patiently achieved such successes. But we must to work. Let us return to the prosaic "bruiser." A whole description lies in the name. A disc of glass in shape and preferably in size similar to the speculum, the "bruiser" is used as a fore-runner of that precious mirror. When we have placed the emery first upon the tool, and with our finger's end

have carefully searched for treacherous grit, then, before the yet unpolished speculum is applied to the emery, the "bruiser" bruises the coarse emery to fine. So when the mirror is ground, scratches, the bane of the amateur optician, are avoided. Not that they matter much, stopping as they do, but a very minute portion of the incident light from being reflected. but they are at best unsightly, and one would do well to avoid them. The bruiser is not required in the earliest stages of the grinding, for then grit which the fingers fail to detect may be safely allowed to pass. A small bruiser acts perfectly well, and although its use may be, and is, in some cases of experience scorned and dispensed with, I would advise the use of one, in a case where the speculum does not exceed 6 or 7 inches in diameter, nearly of the same size as the speculum. It will be required each time that fresh emery is brought into use during the finer grinding. If the reader is rough grinding by Professor Thomson's method, he may gain some experience by first obtaining two small discs of glass, and roughing out this "bruiser," for after all it is nothing more or less than a small unpolished speculum. If, on the contrary, metal tools are being used, and they have been nicely cast and turned in the lathe to the gauge (next to be described); have been worked one upon the other as directed, and finally carefully scraped and trued until contact is complete: then he may shape his bruiser upon the rougher convex leaden or pewter tool, and smooth it with flour emery upon the finer tools, and so gain similar experience. Should the curvature of the leaden tool flatten while roughing out, it may be hammered on the back until the original convexity is restored; but I suspect very few of my readers will trouble about metal tools at all.

Lastly, for the benefit of those who suffer from want of decision, I will say that the "bruiser" should be at least 4½ inches in diameter for a 6½ inch mirror. It need not be of any special thickness, nor need the edges be specially ground in the lathe.

In the first paper of this series will be found inscribed "*The focal length of a speculum is one-half of the radius of curvature.*" I hope my readers have set this fact to heart; if not, they had better refer to the paper in question and examine it. It will then become apparent that if we select a special length for our telescope we have merely to double that length, obtain a pair of compasses having a stride equal to the doubled length, and with their aid, strike an arc which will be the curvature required for the mirror. Let us do this. The diameter of the proposed speculum shall be 6½ inches, the reader being at liberty to make it larger or smaller to suit his ambition or his convenience. The focal length shall be about ten times the diameter (see first paper), or five feet. Again the reader may depart from the fixed length in proportion to his private appreciation of his own skill. If that appreciation be great, he may lessen the focal length—if little, extend it, when straightway the difficulty of accurate construction will lessen. It will be as well, however, to trust to perseverance, and adopt the focal length of 5 feet, and the diameter of 6½ inches.

Twice five are ten. Whence can we obtain the compasses with a stride of 10 feet? We must abandon the idea, and use a radius bar instead. Procure a piece of deal, 11 feet long, about 2 inches wide, and ½ inch in thickness (Fig. 24). Any piece of wood of dimensions slightly greater than these can be utilized. A few inches from one end pass through the lath an awl to form a pivot around which the lath may be moved. At a distance of ten feet exactly from this awl, fix in the deal a small steel rod or tool sharply pointed, projecting about 1 inch on the under side.

The gauges are two pieces of sheet metal, the one having a convex, the other a concave edge. If the radius bar above described be hung by the awl upon a convenient wall, the steel point will describe part of a circle, an arc of which will be the curve required for the gauges. So a plate of metal (thin sheet zinc or brass) about 7 inches square, carefully tacked under the steel point, marked deeply with it, and finally cut to the mark, will form the gauges. A convenient wall being generally unattainable, a long room or a passage may be pressed into service, as indicated in Fig. 24. The metal plate is seen tacked (slightly only) to the floor, and the lath with steel point, ready for cutting the curve. In Fig. 25 the completed gauges are shown, as also the manner in which the edge is turned back (when the metal is thin) to give rigidity to the whole. Having cut the gauges, a true curve should be obtained by the same process that we adopt in the speculum grinding, by working the edge of the one against the other with emery between them. To do this conveniently and correctly, the gauges may be laid upon a flat board wetted with flour emery and water, one held firmly, and the other ground to it until they touch at every part. Now bore a hole through each gauge, and hang them carefully away lest they should become lost when the working of the speculum is advanced. The concave A held vertically over the tool will indicate when the proper curvature is reached. The convex B will similarly indicate when the speculum is of its intended focus of 5 feet.

Some difficulty will probably be found in making these gauges in thin metal, which difficulty can be avoided if the reader possesses a glazier's diamond: for they can be formed of glass. A thin sheet of common window glass of the necessary size should be

selected in place of the metal, and the cutting diamond substituted for the steel point. The glass gauges when cut must be subjected to the grinding process above described.

The steel point should not be diamond shaped, but with a square edge (something like a tiny parting tool), so that it will divide the metal by cutting a narrow channel with perpendicular sides.

To summarize, we now have in our workshop: (*a*) a bench or barrel; (*b*) a block upon which the tool can be cemented; (*c*) two glass discs nicely edged, the one for the tool, the other for the speculum; (*d*) two smaller discs of glass to form the bruiser; (*e*) convex and concave gauges.

Add to these sundry bowls for clear water, a Turkey sponge or two, and a few tiny boxes or jars or bottles for the emeries and rouge.

Not a very expensive paraphernalia, when we consider, that from one of those discs of flat glass, we shall furnish a wondrous instrument of a size and power that was unknown to the world, scarcely more than two hundred years ago.

If the metal tools are used, the following list will have to be substituted for the above. It is given for comparison: (*a*) as before; (*b*) bench screw; (*c*) large glass disc for speculum; (*d*) small glass disc for bruiser; (*e*) as before; (*f*) convex and concave metal tools; (*g*) convex leaden tool for rough grinding.

The speculum grinder's workshop is furnished, except that he has yet to provide the materials wherewith he grinds—sand, emery, rouge. Sand—the common fine quartzose river sand serves excellently for this purpose. It is similar to that used by the mason for polishing his marble; perhaps, if a neighbouring polisher of marble of a genial disposition can be found, the demand can at once be supplied. In any case "silver sand" can be easily obtained. Be careful that it is clean and even grained, and that any grit is removed, preferably by the aid of a small sieve. The manner of applying the sand will be presently told. When sand is very fine it loses its cutting power, and then the optician has recourse to emery. Indeed, sand is used only for the roughest work as a matter of economy; emery of a coarse grain serving the same purpose, but being more expensive. The emery during its manufacture is sifted through wire sieves of varying grades, the degrees of fineness depending upon the size of the grains, which in their turn are regulated in size by the number of holes in each square inch of sieve through which they have passed. These grades are numbered, and we shall require, using sand for the roughing out, forty, sixty, and ninety-hole emery. In addition to this, for the finest grinding, flour emery must be obtained. This latter is of two kinds, washed and unwashed. By the process of washing, matter other than emery is got rid of, leaving the pure cutting mineral, and this is consequently dearer. Let my readers, then, obtain washed flour emery for the process I am about to describe; and here a word of advice as to its selection may be given.*

Emery of good quality should present under microscopic examination a uniformity of grain and freedom from dirt. The larger qualities should be of a dark brown, almost black colour, but washed flour emery should be bright chocolate and present a *clean* appearance. A comparison of samples of washed and unwashed will indicate sufficiently my meaning. Occasionally a yellowish-tinged sample may be obtained and cuts very readily, but emery of a dark slaty hue should be avoided since it is adulterated.

The optician requires, however, emeries of far finer grain than the finest supplied by the emery mills. To obtain this, the professional artist resorts to a process of elutriation. He thoroughly washes the emery mud which is the result of the rough grinding with coarse emery, and from that obtains the finer emeries required. An accumulation of such mud, is, however, necessary, and for the reader it will be safer to substitute for it washed flour emery.

The great requisite in elutriation, as in all other of the processes of speculum working, is care. According to the care (and cleanliness) with which the washing is performed, will be the success in the fining. Take two pounds of washed flour emery, and mix it thoroughly in a vessel containing about one and a half or two gallons of water. If rigid economy is to be practised, a lesser quantity of emery will suffice. Stir up the mixture thoroughly for a short time, and then suddenly stop the agitation and watch what will happen. The water gradually clears, while to the bottom of the vessel fall the coarser grains of emery, followed by those of medium size, until, when ten or fifteen minutes have elapsed, a thick sediment has deposited, and the water has become comparatively clear. Yet in that water is held the most valuable of the emeries that we require. It will be seen then, that by drawing off the water at any given time we carry with it emery of a given grade. This is the process generally adopted, except that a little mucilage of gum arabic is sometimes mixed with the water, to cause it to retain the emery longer in solution.

Different workers have allowed the emery to

* My readers will acquit me of any other desire than that of studying their convenience when I tell them that Messrs. Oakey and Son inform me that washed flour emery manufactured by them, can be obtained in any town in the United Kingdom, and would cost probably about 1s. per lb. I have always paid a much greater price than this myself, but a sample of the above-mentioned which I have seen appeared to satisfy the requirements of the speculum grinder.

remain in solution for different periods of time, consequently obtaining different grades. The eminent lense maker Mr. Ross used six grades, as follows:—
1, ten seconds; 2, thirty seconds; 3, two minutes; 4, ten minutes; 5, twenty minutes; 6, sixty minutes.

Mr. Charles Tulley, of Islington, an optician of repute, also used six grades, namely: 1, one quarter of a minute; 2, one minute; 3, two minutes; 4, six minutes; 5, fifteen minutes: 6, thirty minutes.

Lastly may be quoted the grades used by Professor H. Draper, of New York University, an amateur who devoted much time to the successful working of glass specula:—1, three seconds; 2, twenty seconds; 3, one minute; 4, three minutes; 5, ten minutes; 6, thirty minutes. From these tables it will be seen that no particular times are necessary, providing only that the grades rise in regular order from the finest to the coarsest. That this last rule is imperative if rapid fining is to be insured, will be recognized when the reader remembers that the work of each grade is to remove the marks left by the previous one. Adding to each of the two latter tables a seventh grade of sixty-minute emery, either of the three plans can then be selected to work by. The impalpable powder that remains in solution after one hour has elapsed may be wasted. It appears to have no effect upon a glass surface, and is excessively difficult to collect in the smallest quantity. The water containing the suspended emery may be either siphoned off or decanted. Care must be taken not to disturb the coarser emery that has subsided. The methods of collecting the fine powder that finally deposits varies. When a considerable quantity of emery is elutriated at one time, the water containing the suspended mineral is siphoned or decanted into bottles, which each serve as a permanent receptacle for a particular grade of emery, and from which it is afterwards used in thick solution. But such a method is not advisable when the total quantity obtained of each of the two finer grades would scarcely fill a teaspoon, as will be the case with the small quantity of emery in question. Probably each speculum worker has his private process of collecting the sediments. That of the writer is to decant (or siphon) the water containing the suspended emery into a large shallow basin, where it is carefully covered, in a clean room, to protect it from dust and grit. When a period of time sufficient to throw the finest emery down has elapsed, the water will be clear and can be returned to the first vessel for use again. The thin coating of emery which is adhering to the inner surface of the basin is thoroughly dried, and then rubbed with the tip of the index finger. The powder at once leaves the glass (or finely-glazed earthenware) surface, and accumulates at the bottom of the vessel, whence it is transferred to a small box and set aside, amply protected from dust, for future use. The same plan is followed with each grade, and will be perfectly successful if care is taken to slowly dry the powder before rubbing it together. This method obviously demands the most scrupulous cleanliness of basin, fingers, and box, a demand which my readers will have no difficulty in complying with. It may seem somewhat unnecessary to devote such care to washing the grinding material, but it should be remembered that with the speculum worker the sand, emeries, and rouge, by their grades represent a series of tools, each one of the series preparing the glass for treatment with a finer tool. One grade is unfitted to do the work of another. It would be impossible to complete a speculum with one grade of emery alone; only by working with a carefully proportioned set of emeries can success be attained. Moreover, the presence of one grain of a coarse grade in the emery used in the final process would necessitate regrinding. It has been mentioned that the quantity of emery of the finer grades obtained would scarcely fill a teaspoon. Nor is this a disadvantage. The small amount of each sufficient to work a large glass surface will give cause for surprise to the embryo optician. Moreover, the use of a greater quantity would be dangerous to his prospect of success. The closer the surfaces of the tool and speculum can be worked together, the better will be the curve obtained. The lesser the quantity of emery upon the tool the more evenly can it be spread, and its action on all parts of the surface (independent of the natural tendency to

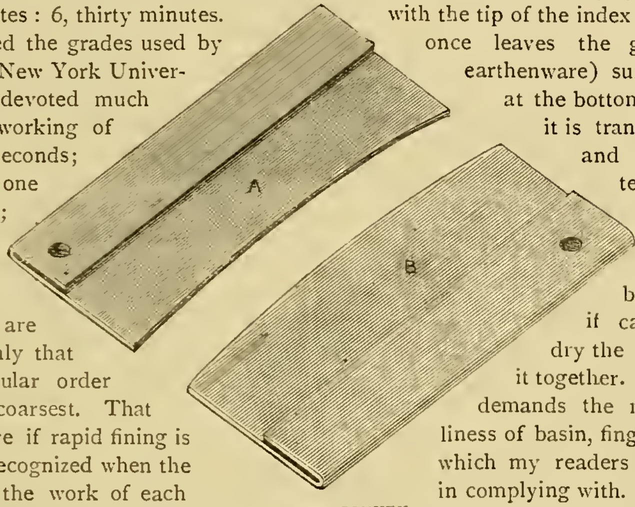


FIG. 25.—THE CONVEX AND CONCAVE GAUGES.

FIG. 24.—MODE OF CUTTING THE GAUGES.

excavate the speculum) tends to be more uniform. But this will be seen when we come to the working.

"There is a thing," wrote one William Shakespeare, "which thou hast often heard of, and it is known to many in our land by the name of pitch," and none have better reason to know the fact than the speculum workers. Like a good-natured friend, pitch often becomes useful when least expected and most wanted.. It is used for cementing glass to glass or any other substance, and, as shown in Chapter II., it is also used for the polisher. So the reader must add this necessary to the other articles in his workshop. The manner of using it as a polisher will be hereafter described; in this paper we will regard it merely as a cement. When cementing with pitch the articles to be cemented will require to be fairly heated, so as not to chill the adhesive surface of the pitch. It will render this latter evil less likely to occur if the glass is lightly brushed with spirits of turpentine (which should be allowed to dry) before the pitch is applied. Sifted wood ashes, mixed with the pitch in the proportion of about two parts of the former to seven parts of the latter, will absorb the essential oil and render the cement less adhesive. This mixture is used by the speculum grinder, only when very small or delicate work is being done. For ordinary purposes the native pitch suffices. To harden pitch, boil for some time, or add resin; to soften it, add spirits of turpentine or tallow. To toughen it add wax. When a large surface of glass is to be cemented, as, for example, the speculum to its backing, for the process of figuring, or when the glass requires frequently to be removed, it is occasionally found necessary to lessen the adhesiveness of the cement. This is done, not by adding wood ashes, but by turning rings in the pitch surface to which the glass is to be fastened, or by laying narrow ($\frac{1}{2}$ inch wide) slips of paper over the same surface at intervals. It will be seen that in either case the adhesive surface is reduced. Such precautions will be unnecessary if the speculum be a small one, and the glass of which it is constructed of the proper thickness.

To remove a disc of metal or wood from a speculum there is but one proper way. If the speculum is small, hold it in one hand, and strike the disc of wood or metal smartly with a wooden club. If the speculum is large, it may be held with both hands or laid face downward upon a pad, and the stroke given by an assistant. Superfluous pitch which may adhere to the glass surface may be removed by careful scraping and the application of naphtha. When turning pitch the fragments flying from the tool will adhere to the flesh and are extremely hard to remove. Care should therefore be taken to prevent them flying about. Melt the pitch, if possible, in an oven. If the open fire must be used, the greatest caution is necessary to prevent a conflagration. Finally, pitch suitable for our purpose can be obtained in small boxes of one pound each, for about twopence each box.

The rouge is a mixture of the red and black oxides of iron. The red is too soft to be of much value in glass cutting, the black too hard. Rouge of the kind proper for glass polishing has a purple tinge, and costs about six shillings for a pound. Two ounces only (probably less) will be required for the polishing, the only process for which the rouge is required. It is made—I write for those who find themselves unable to procure it—by mixing filtered solutions of sulphate of iron and caustic soda. The grey oxide of iron which will be precipitated from the mixture is repeatedly washed and finally calcined at a dull red heat in an open crucible. It passes first into red oxide and finally into black. The intermediate or purple stage is that required by the optician. It should when sufficiently calcined be ground to powder and elutriated, and it will then be similar to that which can be purchased of the chemist. It commercially bears, I believe, the name of "jeweller's rouge." The method of using it will be detailed when we are polishing the speculum.

The workshop is now completely furnished. It merely remains for me to direct the attention of the reader to the engraving in the last paper, and to ask him to study the position of the workman represented there. The "bruiser" is shown on the shelf to the right of the picture. Let the intending optician also study any book to which he has access in which the telescope is discussed or described, so that he may work later on intelligently.

(*To be continued.*)

SMITHING AND FORGING.

By GEORGE EDWINSON.

I.—INTRODUCTORY.—THE SMITHY, FORGE, BELLOWS, FAN, ETC.

BEFORE concluding a former series of articles on "Brazing and Soldering," in Vol. II., I had occasion to briefly mention the art of welding pieces of iron together, and to show that this process was closely allied to autogenous soldering. Brazing together articles of iron and steel is a work also closely allied with that of smith's work, and thus it will be easily seen that one art or trade dovetails, so to speak, into another trade, and we can scarcely draw a strict line of demarcation between them. New subscribers to this journal will find it to their advantage

to get the back numbers, for in those articles, and in others by my fellow-contributors, they will find much to assist them in understanding the present or forthcoming series of papers. Readers, also, of my articles on "The Handy Man in Farm and Garden" will do well to study these on "Smithing and Forging," where smith's work on the farm or garden is required, since the details of the work will be given in this series.

As there are Smiths many by name, so there are also smiths many by profession : hence we have goldsmiths, silver-smiths, copper-smiths, coach-smiths, lock-smiths, white-smiths, and black-smiths, besides many others too numerous to mention here ; but it is of the latter I propose writing, of the trade about which the sweet American poet, H. W. Longfellow, sang so vigorously in his soul-stirring song on "The Village Blacksmith." I love that song when sung by a good baritone voice to the tune so well adapted to the words by Weiss, and I love the trade of the village smith. Long before I knew anything about Longfellow and his poem, did I, a little fellow in petticoats, with other boys, gather around the village smithy, and

"Look in at the open door."

His homely words therefore find an echo in my mind when he says :

"They love to see the flaming forge,
And hear the bellows roar,
And catch the burning sparks that fly
Like chaff from a threshing floor."

Ah ! those were merry, happy days when I learned to respect the brawny smiths who toiled

"Week in, week out, from morn till night,"

and on the seventh day wrought on our youthful hearts in the Sunday-school ; and I learned many a lesson from them although not apprenticed to the trade.

The trade of the smith is the most ancient and the most honourable. It is, perhaps, the oldest of which we read in the Bible, where Tubal-cain stands as its representative ; it is one of the oldest mentioned in heathen tradition and mythology, where the name of Vulcan is mentioned as the smith who forged the thunderbolts for Jove ; and it is almost certain that other trades are indebted to it for their tools. Invaders of peaceful countries were wont to recognize the value of the smiths by carrying them off with other treasures. Thus we read in 1 Samuel xiii. 19, that the Philistines carried off all the Hebrew smiths, and by those tactics ensured a monopoly in the smithing trade to the Philistine smiths. Such tactics would fail in modern times in our own land unless the conquerors carried a large bulk of the male population into captivity, and the scheme will have less chance of success in the future by reason of a wider diffusion of knowledge on this and kindred subjects by the aid of technical journals, such as AMATEUR WORK, and such useful companion handbooks as "Every Man His Own Mechanic."

The Smithy.—The first requisite to a professional or intended amateur smith is that of a workshop. Some other trades, such as shoemaking, bookbinding, tailoring, and even carpentry, can be carried on in the living room or the kitchen of a cottage, but the work of a smith demands a separate workshop all to himself away from the main building. This workshop may be an open shed, or a shed open on one side only, a lean-to or linhay, or it may be a properly-planned and well-constructed workshop, according to the wishes and means of the workman. An open shed might serve his purpose in summer time, but the draught would be injurious to health in winter, when even a shed open on one side could be scarcely tolerated. I have therefore planned a workshop which may help my readers to provide for themselves a snug and convenient smithy. This may be built according to the plan, to the dimensions shown thereon, or a building may be altered to suit the requirements sketched on the plan. The building may be of stone, or of brick, or of both combined, or a good smithy can be erected with a wood or iron frame and corrugated iron plates if these are found cheapest and most convenient. A wooden building does not commend itself as suitable for a smithy, since the risk of a flare-up would be great, but, nevertheless, wooden smithies have done some useful service, with the exercise of ordinary care. Concrete or cob walls may be erected for the purpose, if the amateur knows how to build them, and will be found less costly than those of brick and stone where these last materials are scarce. Space cannot be spared here for the details of building construction in stone or brickwork, or in that of carpentry for the roof, but my readers can obtain the information in full in the pages of "Every Man His Own Mechanic." A few words of explanation as to the plans herewith given will, however, be advisable. On referring to the elevation (Fig. 1) it will be seen that a piece of squared timber is built into the front wall from the forepost of the door, at a height of 2 feet 6 inches above the ground. This piece of timber serves the double purpose of a support for the long window frame and a firm support for the vice bench, the frame of which is to be securely fastened to this support by a few bolts or coach screws. It will also be seen that a single length of squared timber forms the upper support of door and window alike, thus ensuring strength in those parts. I have planned the door to open opposite to the forge for the purpose of ensuring plenty of fresh air and a good draught when winds are contrary and smoke is blown down the

chimney, and also to ensure a ready ingress and egress to and from the forge fire for long pieces of metal. The light from the doorway and from the window will also fall on the front left-hand corner of the anvil; and be thus convenient for the workman.

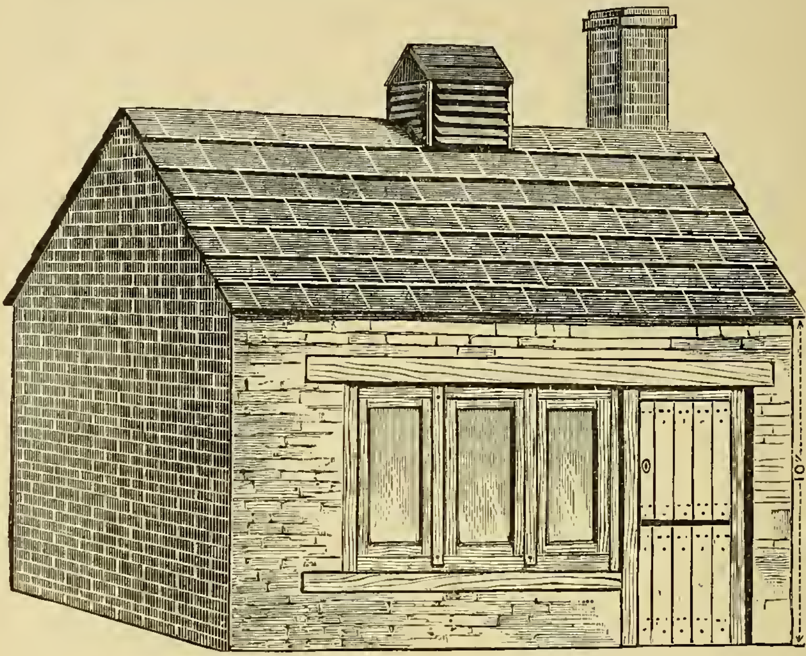


FIG. 1.—EXTERIOR VIEW OF AMATEUR'S SMITHY IN ISOMETRICAL PERSPECTIVE.

The door is made in two parts, to allow the upper part being left open, if required, whilst the lower part or hatch remains bolted. It will be seen that the sash frames of the window are three in number only, and thus form three large panes of glass. These should be of stout ribbed or diagonal glass, and the frames may be hinged to open outwards, or fitted in grooves cut in the window frame; if the latter, it will be well to have the centre supports loosely fitted in the frame and held by screws as shown. Then, in the hot days of summer, the whole window may be removed and the front laid practically open. The weather board ventilator on the top of the workshop will be a welcome addition at all times, since stray smoke from the forge will readily ascend to this highest point and pass out between the slanted boards. The sketch clearly shows its construction. Turning to the interior as shown in the plans, Figs. 3 and 4, we see that the forge is planned to be built in one corner, opposite the doorway, and the reasons for thus planning it, in addition to that before mentioned, are as follows: In an amateur workshop, economy of space is much desired, and this is secured in this instance by placing the forge in this corner. It also leaves most space on the right hand of the workman, and gives him a corner for his chimney and his coal store. Now, I am aware that this position is not the most convenient for the amateur engineer and machinist, since long pieces of shafting cannot be heated up in the middle for the purposes of welding, forging or upsetting them, but I have provided for this emergency to a certain extent by planning a small window or hole on the opposite side of the forge fire, and on a level with it, through which the long iron shaft can be run when heating it in the middle. Nevertheless, if the smithy is likely to be used for such purposes, it will be advisable to build the forge abutting against the centre of the back wall, and to alter the plan of the front of the shop, placing the door in the left instead of the right corner. These

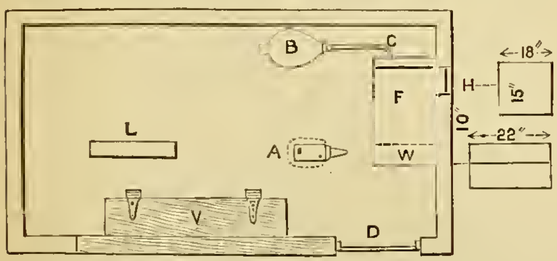


FIG. 4.—PLAN OF SMITHY, SHOWING INTERNAL ARRANGEMENTS.

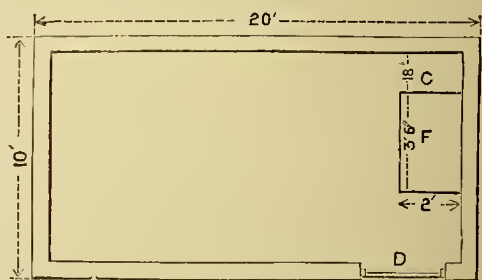


FIG. 3.—GROUND PLAN OF SMITHY.

A, Anvil; B, Bellows; C, Coalpit; D, Doorway; F, Forge; H, Forge-hole; L, Lathe; V, Vice Bench; W, Water Trough.

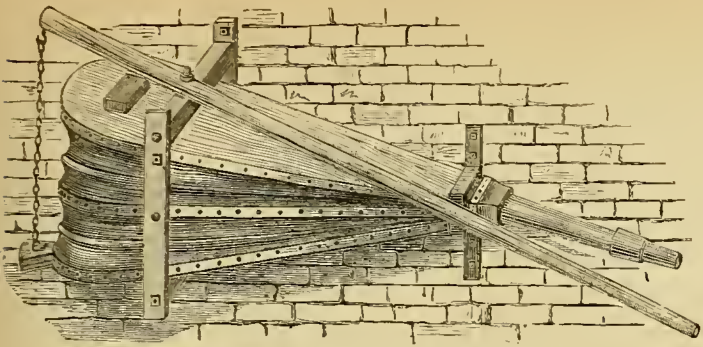


FIG. 6.—SMITH'S BELLOWS.

considerations need scarcely be entertained if a portable forge is selected, for then it can be easily drawn from its corner and placed in a favourable position for heating an exceptional job like this.

The Forge.—Now respecting the forge itself, the fireplace on which the iron of the smith is to be heated—the smith's hearth, as it is sometimes called. I shall not stay to describe the method of making a portable forge, since that task has been taken up by a fellow-contributor, but will describe the fixture shown in the sketch (Fig. 2). The foundation of this structure up to within one foot of the top may be of stone, but the finishing courses should be of firebrick bedded and jointed with fireclay, as should also be the wall at the back of the hearth around the tue-iron, or *tuyere*, as it is sometimes called. In building the forge, let every course be well bound with pieces of hoop iron, and have the upper course of bricks bound by a rim of iron 4 inches wide with half its width below the edge of the bricks and half above it to form a pan for the hearth. This rim should be of $\frac{1}{4}$ inch

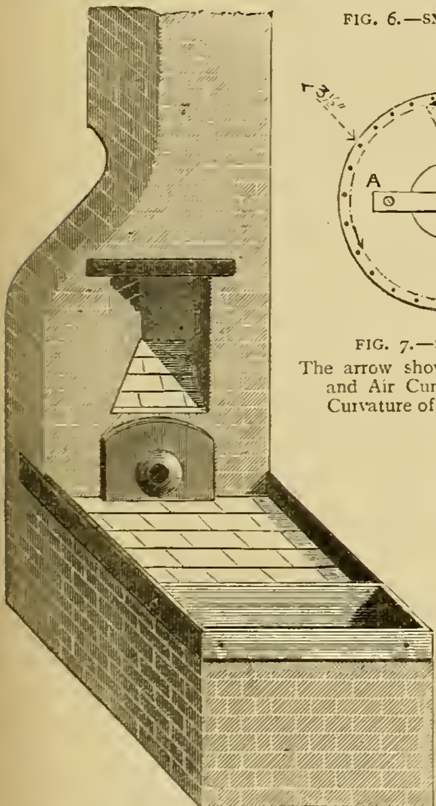


FIG. 2.—SMITH'S HEARTH OR FORGE.

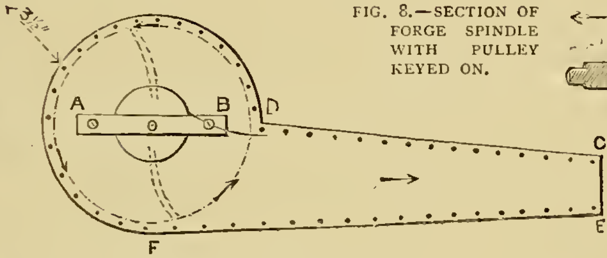


FIG. 7.—SIDE ELEVATION OF FAN.
The arrow shows direction of Revolving Vanes and Air Current. Double curved lines show Curvature of Blades.

FIG. 8.—SECTION OF FORGE SPINDLE WITH PULLEY KEYED ON.

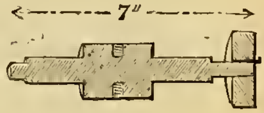


FIG. 10. — SECTION ACROSS SPINDLE AND COLLAR, SHOWING HGLE FOR SHANKS OF BLADES.

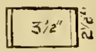


FIG. 11.—PLAN SHOWING DIMENSIONS OF FAN'S MOUTH.

FIG. 9.—FORM OF BLADES OR VANES OF FAN.

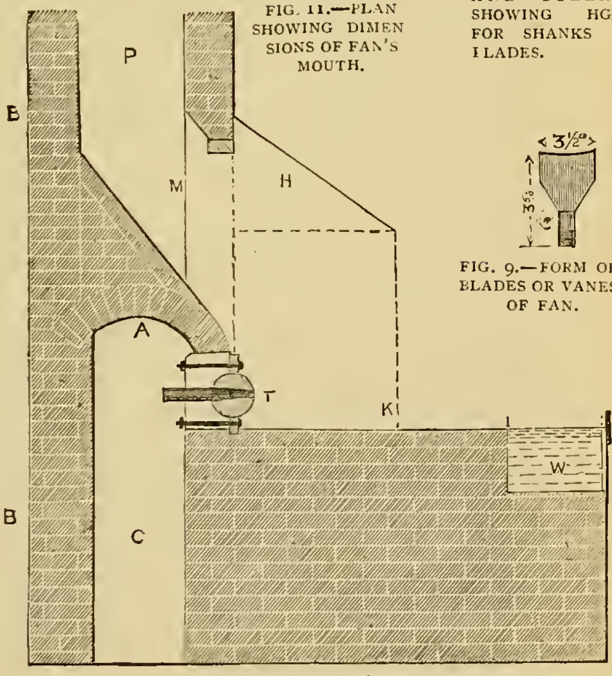


FIG. 5.—SECTION THROUGH SMITH'S HEARTH OR FORGE.
A, Arch; B, Back Wall of Forge; C, Coal-pit; F, Flue; M, Mouth of Flue; H, Hood; K, Hearth; T, Tuyere; P, Pipe from Fan or Bellows; W, Water Trough.

iron, and the ends of it must be secured to the back wall by ⅝ inch bolts built into the brickwork. The fire back and tue-iron may be bought for the purpose and built in, or a makeshift can be readily put together with 1 inch thick iron plate, and a 14-pounder iron shot or ball. Bore a ¾ inch hole through the ball and enlarge this to a taper hole of 1 inch on one side. Next cut and countersink a hole in the iron plate large enough to take one-third of the shot, and have the shot and plate built into its place for fire back and tue-iron. It will be advisable to bore four ½ inch holes in the plate before fixing it there, and to secure it by bolts passing through the wall and held by nuts and fish plates. The flue may ascend by a slanting hole just above the fire back, or it may spring from the top of an iron hood fixed against the back of the forge against the end wall and sloped down as the brickwork slopes. For my own use I prefer the former, as shown in the sectional sketch, Fig. 5. Before the last course of bricks is laid on the forge we must fix a water or slake trough thereon in the position shown. This trough may be of sheet iron, cast iron, or of stone, just as may be found cheapest and most convenient, the dimensions being as shown on plan, namely, 10 inches deep and wide and 22 inches long; this will easily fit inside the rim of the hearth and may be bolted to it if made of sheet iron. Some smiths like to have an additional iron trough for coals next the water trough, and, if the amateur smith desires such a convenience, he can secure it by merely placing a sheet iron division across the forge and fastening it to the rim by a few rivets. The coal store proper is formed at the back of the forge, where a shallow pit is dug under the arch of the flue. If a fan is employed to raise the blast for the fire, this arch will form a chamber for the fan in addition to its use as a coal store, but if a bellows is used, it will probably be supported on a pair of stout iron brackets bolted to the side wall, and the pipe from the nozzle of the bellows to the back of the tue-iron will be carried down, and pass into it beneath the above-mentioned arch as shown on the plan (Fig. 4). The floor of the smithy may be laid after the forge has been built and the coal pit formed. In many country workshops this is formed simply of earth beaten down hard, but a clean and durable floor may be formed of smiths', or foundry, or boiler clinkers, wetted, sprinkled with a little Portland cement, and rammed down hard and level. If some cinder ashes from a smithy can be procured, treated in like manner, and a thin layer beaten down on top of the rough bed of clinkers, a smooth and durable floor can be made. Ordinary stone floors, paved floors of stone, and concrete floors made in the ordinary way are apt to play the workman some unpleasant tricks should a piece of hot iron be thrown upon it—an accident not at all unlikely to happen in a smithy.

The Blast.—The blast required to raise a piece of iron on a smith's hearth to a welding heat is variously estimated, according to the size of the work to be welded, but the approximate quantity of air necessary to be forced into the fire to produce a welding heat may be roundly stated at 150 cubic feet per minute, and this may be secured from a 9-inch fan driven at a speed of about 360 revolutions per minute, or from an ordinary double-action smith's bellows. Much good work has been done by bellows, and those useful tools can be obtained in various forms and prices, from the simple small pairs for amateur forges at about 25s., up to those costing several pounds. They are usually worked by a long lever or handle, attached as shown in Fig. 6, or by a treadle actuating a lever and worked by the foot. In some portable forges they are fixed beneath the pan, in others they are slung up behind, whilst circular bellows are not infrequently met with, placed under the arch over the coal-pit, behind the forge.

Bellows should be frequently cleaned and oiled, and treated as leather boots for hard wear are treated to keep them soft. They should be slung up by a chain when not in use—that is, with the parts braced together, and only opened for use as a melodion is opened. But bellows are fast going out of use and are being superseded by fans, because these give a more steady and constant blast, and are more easily kept in order for a longer period than bellows. Under no circumstances should I advise an amateur to make his own bellows, but he may be able to make a fan for his own use by the aid of the annexed sketches and the following instructions. Cut out two sides for the fan from ⅛-inch sheet iron to the pattern shown Fig. 7, and of the following dimensions: 9 inches across at the widest part, 2½ inches across the narrowest part, and 2 feet in length. Strike a circle as shown by dotted lines on the sketch, Fig. 7, and within this another circle 3½ inches in diameter. Cut out the pieces of iron enclosed by the inner circle, and thus leave a hole 3½ inches in diameter in each side to receive the spindle of the fan, and as an intake for the air. Next, drill two ⅜-inch holes for the short bolts A and B, and file the holes to fit square-shanked bolts; then drill a number of holes for rivets in the positions marked on Fig. 7, and proceed to rivet on the casing. The casing is to be formed of thin sheet iron (say $\frac{1}{16}$ in.), cut out in strips 5 inches wide; the first strip should be 14 inches long. Mark off two margins to this strip of ½ inch each margin, and bend down each margin to the marking-off line, thus leaving 4 inches clear within the lines, place this strip in its position from C to D, enclosing the two side

pieces, and mark the holes for the rivets with a piece of slate pencil passed through the rivet holes in the sides, secure the marks by dots from a centre punch and drill or punch the holes, also drill a row of holes across the end of the strip at D.

The next strip should be 20 inches long, but of the same width as the first; this strip must be marked, bent, and have holes for rivets to match the rivet holes from E to F, and an additional row of holes across the end of the strip at F.

The next strip must overlap the ends of the two former strips, and pass around the drum of the fan from D to F; the length will probably be 22 inches, but it will be best to test the actual length with a measuring tape, and cut the strip to the measure thus obtained. This strip must be marked and bent as the others, but now some little difficulty will be experienced in bending it over the drum and securing a proper form to the margin, unless the precaution has been taken to mark the distance of the rivet holes before turning down the margin and cutting nicks like saw teeth gaps between each rivet hole; if this has been done the strip will bend down and may be fitted without buckling, but the professional smith would condemn such a job as a "botch," and insist on hammering out the buckles.

In riveting the strips to the sides, commence at C and rivet both sides on to D; then put on the strip to both sides from E to F, bending down the strip as the rivets are inserted; lastly, put on the most difficult piece, riveting it to F, passing in the rivets through the side holes and also the left hand with a piece of stout iron to back up the rivet head, and finish off by riveting it to D. Fully one foot length of this strip must be left until the spindle and blades of the fan have been put in, and then it may be found most convenient to close the remaining part with short, thin-headed bolts, with nuts on the outside.

Another, and perhaps easier method of doing this job, will be as follows: Cut the side pieces fully 2 inches longer and wider than the before-mentioned dimensions, and turn flanges to these instead of the thin pieces, turn the flanges outward and rivet the thin strips to those flanges. In this way both bolts and rivets may be easily put in, and no danger from buckling of the plate may be apprehended, since the outer edges of the flanges around the drum will stretch with a little hammering.

A section of the spindle is shown at Fig. 8. Its construction is as follows: Cut off a 7 inch length of $\frac{3}{4}$ inch round iron bar, and turn it quite smooth from end to end; next forge a collar for the spindle 2 inches wide and 2 inches in diameter, and turn this to almost, but not quite, fit on the spindle. Then draw a mark around one end of the spindle about five-eighths of an inch from the end, and turn this part down to $\frac{1}{2}$ inch in diameter with a sharp shoulder; at the other end of the spindle mark off $2\frac{1}{8}$ inches, and turn this down to $\frac{1}{2}$ inch in diameter, also leaving a sharp shoulder as shown in Fig. 8.

From one of those shoulders inward, measure 1 inch, and slightly burr the line with a cold chisel all around the spindle, this will mark the position for one edge of the collar; now make the collar red hot, slip it on the spindle to the burred part and then cool it in water; this will cause the collar to shrink tight on the spindle. This is termed shrinking a collar on, and to do this successfully the hole in the collar must be perfectly uniform in size, and must be slightly smaller than diameter of the spindle. When the collar is made red hot it will expand enough to slip on easily to the cold spindle, but will shrink tight on the spindle when cooled.

If preferred, the collar may be forged on, and turned up with the spindle afterwards—and this is, probably, the method which would be employed by the professional smith. Exactly in the middle of this collar and on four opposite sides of the same, drill four $\frac{5}{16}$ holes to a depth of $\frac{5}{8}$ inch, and tap them (*i.e.*, cut a screw thread in them) with a $\frac{3}{8}$ inch tap.

If now it is suspected that the collar has not been shrunk on securely, each hole may be extended with the point of the drill slightly into the spindle and the pointed ends of blade shanks made to sink into the pits thus made.

The blades of the fan may now be forged out of $\frac{5}{8}$ or $\frac{3}{4}$ round iron to the form and size shown at Fig. 9, by upsetting and flattening the ends of the iron to form a blade $\frac{1}{16}$ in thickness; or pieces of $\frac{1}{4}$ inch plate may be cut out and welded to short lengths of $\frac{5}{8}$ inch round iron to form arms and then forged to the required thinness; or the same pieces of plate or even thinner plate may be fitted and riveted into slots cut in the arms. Whichever form and method is adopted, the following finishing strokes must be given to it: the ends of the arms must be screwed to fit the holes in the collar on the spindle, and the blades slightly curved to nearly approach a scooped form; additional power and a steadier blast will also be obtained by bending the arms so as to cause them to deviate slightly from a concentric position.

The arms should be fitted in their places before being put in the drum of the fan, and unscrewed again for the convenience of placing them in the drum.

The bearings of the spindle will be secured by placing a length of $\frac{1}{2}$ inch brass bar across the central openings, and bolting it to the side of the drum as shown at A B, Fig. 7. This piece of brass should be at least $1\frac{1}{4}$ inches wide, and have a true smooth hole bored in it to receive the ends of the spindle.

In placing the parts in position, put on one of the bearings, pass the spindle into the drum, then slip on the other bearing, and bolt all on securely, then screw in the blades through the opening left on purpose in the casing and leave each blade standing slightly athwart or askew the spindle, see that they revolve freely without striking any part, and then close up the drum.

It will have been noticed that $1\frac{1}{2}$ inches of one small end of the spindle protrudes beyond one of the bearings; this must be on the side to which the driving pulley is to be fixed, and this end should have a flat place filed on one side to receive the key of the pulley.

The pulley for a broad leather band should be 2 inches in diameter, with a face of $1\frac{1}{2}$ inches; a key-way must be cut in the boss and the pulley keyed up firm to the spindle. If this pulley is driven from a wheel 2 feet in diameter, and this wheel is revolved at a rate equal to thirty revolutions per minute, a speed of three hundred and sixty revolutions per minute will be performed by the fan. A higher speed and power can be obtained by using a larger driving wheel.

The crank for turning the wheel should be near the head of the forge, and may be actuated by hand or by a lever worked with the foot. The details of either arrangement can be easily supplied by the reader himself, as also the means of fitting a funnel-ended pipe to the mouth of the fan and connecting this with the hole in tue-iron.

In my next, I must deal with some other necessary tools and appliances for the smithy.

(*To be continued.*)

A TURBINE WATER MOTOR FOR AMATEURS.

By F. J. DURRANCE.

(*For Illustrations see the Folding Sheet issued with this Part.*)

I SHALL not waste my readers' time by tracing the history of the turbine from its invention to the present period; but will just say in a few words what it is, and then proceed at once with a description of its construction. Our old and tried friend, the waterwheel, is worked by applying water in various ways to the outer rim or periphery. The turbine is worked in an entirely different manner: it receives its supply at the centre, and after doing its work the water *escapes* at the periphery. It works at a very high speed, and having only two bearings there is very little loss by friction, and with a proper supply of water it will realise over eighty per cent. of power. The wheel I am about to describe and illustrate is $4\frac{1}{2}$ inches in diameter. Some of my readers will think this size very small for any practical work; but when we consider that a turbine 30 inches in diameter with a head of water of about 90 feet, and a 9 inch supply pipe, will develope about 80-horse power, it is easy to see that with a proper supply this size will easily run a lathe, fretsaw, or sewing machine, etc. I may say this motor will work totally immersed in water; it can be worked best by a pressure of water, as town's pressure, or a cistern at the top of a building, etc. It can also be worked (but not economically) by compressed air, steam, etc.

I have made all the drawings full working size, but the reader can alter the size to suit his purpose, and even the method of construction if it suits him, as long as he retains the principle. "The turbine consists of TWO main parts—one fixed, the other movable. To quote a recent writer: "The turbine consists essentially of two rims or crowns firmly attached to an axis or spindle, with numerous curved vanes or buckets fixed between. The main *stream* of water which passes through the *fixed* wheel is divided into numerous jets or smaller *streams* which impinge on the vanes or buckets in the *movable* (or outer) wheel, simultaneously at all points of the circumference, and thus produce motion in the wheel." The reader will easily understand this description by referring to the theoretical diagram given in Fig. 18, and the drawing of the different component parts of the machine.

The frame or support to the whole apparatus is shown in Fig. 1. This can be made of a piece of wrought iron about $\frac{3}{8}$ inch thick and 1 inch wide. In the small sketch shown in Fig. 2, which is not full size, another form of construction for the frame is given, but is not so good as that shown in Fig. 1. If the reader can make his own patterns, I should recommend him to make them, and get them cast. A piece of wood about 9 inches by 6 inches and 1 inch thick is planed up, and the frame is bolted or screwed down to it, previously drilling a hole A (Fig. 1) to take the brass bearing (Fig. 3) for the top part of spindle to run in. The spindle or shaft is best made of a piece of steel $\frac{1}{4}$ inch thick and 7 inches long (Fig. 4); a nice tapered point must be made at one end, and made very hard, as this point has to bear the whole weight of the turbine, besides revolving at a high rate of speed. The top bearing (Figs. 3 and 3 A) is made of brass or phosphor bronze. I have shown one method of making it, but the reader can make it any other way which suits his tools the best, of course a plain $\frac{1}{4}$ inch hole drilled through the top of frame would do as a makeshift.

We now want a bottom bearing, or what is better

known as a step bearing ; this should be made of *very* hard brass or phosphor bronze, as it has to resist a lot of wear. I have shown one form in Fig. 5, which can be screwed down to the base—the proper place for this can be found by boring the hole in the baseboard for the bottom part, a little large, then pass the spindle through the top bearing, insert the point into the taper hole in (Fig. 5) ; by turning the spindle round it will immediately adjust itself to its proper position, and can then be screwed permanently down to the base. Before commencing at the wheels turn a piece of brass, as in Fig. 6, which is firmly secured to the spindle near to the bottom—this forms a rest or support for the outer or revolving wheel. I am afraid I have drawn this part rather too shallow, it might be made a little deeper so as to get more holding power, it should be driven tight on to the spindle, and afterwards firmly soldered. The spindle should then be put on the lathe centres, and a light finishing cut be taken off the brass part, so that it will run very true.

We now come to the rims of the wheels, which are made of sheet brass $\frac{1}{8}$ inch thick (Figs. 7 and 8); two of these are required, $4\frac{1}{2}$ inches in diameter, one of them having a hole $3\frac{3}{16}$ inches in diameter inside (Fig. 7). Just a word about these, if they are castings, of course it is very easy, but if sheet brass it had best be fastened on to a wood chuck in the lathe, by either turner's cement, or, better still, with two or three small screws. The holes can be afterwards filled up with a little brass wire and solder. A very clever mechanic could with a very fine parting tool get out the rims for the inner wheel as well, as the small wheel must be $\frac{1}{16}$ inch less than the large one. If made of sheet brass we shall now want another rim of brass (Fig. 9) a little thinner than the others. This is fastened to the *bottom* disc, which is, of course, left *solid*, and forms a clearance space between the two wheels, and allows them to run without touching each other. See part that is solid black in sectional portion of Fig. 2 to the left of the diagram.

The bottom discs (Fig. 1) and the top (Fig. 7) are now fastened temporarily together by a touch of solder or by a couple of small screws. The top rim is now divided into sixteen equal parts. A template (Fig. 7 A) is now made of tin or brass ; this serves to mark off the sixteen curved lines (three of which are shown). These lines must now be cut through the different thicknesses of brass with a thick fret-saw. It would be best to drill small holes (Fig. 7 B) and saw to the edge—not from it ; after sawing, the top rim can be separated from the two lower ones (which are fastened together by the four holes shown in Figs. 7 and 8). We now require sixteen pieces of thin sheet brass the thickness of saw cuts, and of the shape shown in Fig. 10 ; these must all be bent to the curve shown on the template.

We are now ready to put the wheel together. Make hole A in centre of Fig. 8, $\frac{5}{8}$ inch in diameter ; this is to take the brass piece on the spindle (Fig. 6). Solder this and the bottom part of wheel together, being very careful that it shall all run *perfectly true*. Next turn the *inside edges* of the two rims to a slight curve as shown in Fig. 11 : this is for the purpose of allowing the water which is rushing out of the inner wheel to find its way easily into the outer wheel, if the two wheels do not come exactly opposite. Next take one of the vanes shown in Fig. 10, and place it in the curved groove in the lower wheel; then put one on the opposite side, and place the top rim on to the two vanes. The reader will now see that the narrowest part of the vane prevents the two wheels or rims coming together. The other vanes must now be slipped into their places from the edges, and soldered from the top and bottom. To prevent having to saw through the bottom part (Fig. 8) the parts shown in Figs. 7 and 9 could be made complete into a wheel and then be fastened to the bottom part (Fig. 8) by the holes shown ; this would be a neater job. If the bottom rim is a casting it must be made as Fig. 12, which is in sectional outline, the intermediate piece will not be wanted in this case.

We now commence the inner, or fixed wheel ; this is shown in Figs. 13 and 14, and is made in exactly the same manner as the wheel already described. The hole A (Fig. 14) is for the brass tube (Fig. 15) which is soldered firmly in its place on the completion of the wheel ; it must, of course, be perfectly vertical. A piece of large brass tubing must now be procured, or made out of sheet brass, by shaping on a roller and soldering the edges together ; this must be a tight fit in the large hole in Fig. 13, and firmly soldered. Next make a circular cap or top for this tube, as in Fig. 17 ; this may be made of two pieces of thick sheet brass, one of them must fit tightly inside the large tube. Both pieces must have a hole for the small tube to go through. Put the cap over the tube and push it down into its place and solder together. The inner wheel is now finished, it should be a free and easy fit *inside* the outer wheel, as shown in theoretical sketch in Fig. 18, which gives a good idea of the action. The water in the tube is divided as described, and in rushing out catches the vanes in the outer wheel. Square in the face as it were, and it is bound to go round. In Fig. 19 is shown the correct shape and size for the vanes in the inner wheel. I may say, that if the top and bottom edges of the vanes are filed to a sharp edge the solder will take a better hold as a small portion will run in between the grooves.

The fixed wheel and its tube connections have to

be held rigidly between the sides of the frame. There are several methods of doing this—I show two: one in the large drawing (Fig. 21), and a light casting shown in plan and elevation in Fig. 20; the tube could be fixed between two of these and soldered firmly, or fastened with two small screws. A large hole must be made in the side of tube, as in Fig. 16, in which to put one end of the supply pipe; this must be at least one inch in diameter, and as much larger as you like; it will, of course, be soldered into the side of tube. At the other end have a union joint for the purpose of attaching a rubber hose pipe, or any other connection with the supply. One or two large pulleys must be placed on the top to act as fly-wheel and for driving purposes.

I think I have now said all that is necessary. The large sketch (Fig. 21) shows exactly how the whole affair is put together. Hoping that all my readers who attempt to make it will experience as much pleasure from the result as I did myself, I leave the description in their hands, so that they may take advantage of the earliest available opportunity to set to work on the construction of this most useful piece of machinery.

MODEL YACHTS:

HOW TO DESIGN AND BUILD THEM.

By ARTHUR C. HIDE.

IV.—RIGGING—CUTTER—SCHOONER—PENZANCE LUGGER.

YOU must all know the shape of sails which constitute the most commonly used type of yacht—viz., the cutter's (Fig. 14), but I doubt if you are as well acquainted with the Penzance lugger represented in Fig. 15. The schooner, which I dare-say you also know, is shown in Fig. 16. Now these three are the best adapted for model yachts, and I shall therefore confine myself to them, especially as space compels me. When you have done a little more in model sailing, you will begin to get ideas of your own with regard to the different styles of rig, and I hope will carry your ideas out, but for the first attempt or two you had better confine yourself to these three. The cutter's, as I said before, is the style of rig most universally adopted, and you may therefore take it for granted, is considered by most yachtsmen the best; but I am an exception to the rule, although not the only one by a long way, and think that the Penzance lugger will hold her own against a cutter on any tack. In sailing, the great object is to be able to make your boat go as nearly as possible in the direction from which the wind blows, and the closer you can make her "lie" in the wind the better sailer she is considered. To attain this quality there is one point among others to be considered, and that is to have your total area of sail as little sub-divided as possible—that is to say, the less number of sails you get (keeping the same area, and allowing of easy handling) the better for this purpose. You will see then that in the lugger this point is better attained than in the cutter, and that in the schooner it is far from being anything like equal to the other two. However, the schooner, although not a patch on the cutter or lugger in sailing "close to the wind," has her good points, and is therefore not to be put on one side. But you must choose for yourself, only I should strongly recommend the lugger.

The length of spars and masts you will have obtained by drawing out your sail plan: you should leave about $\frac{3}{8}$ in. beyond the sail, each end for lugsails, and $\frac{1}{2}$ in. for gaff sails, and the mast should be about 2 in. longer than the height of the sails.

For the masts get, if you can, some nice bamboos tapering towards the top, and shave off the knots; but if you cannot obtain these use nicely grained pine. If you are able, make the lower and topmasts all in one, and then cut them in half afterwards, joining them again with a brass ferrule about 2 inches or $2\frac{1}{2}$ inches long let flush. This ensures their being nicely tapered to the top. You may give up all idea of caps for your topmast and cross-trees, and all this sort of paraphernalia, the great object in models being to get all *top* weight as little as possible, and so not only to get more weight on the keel, but to make the rigging simple, so that it can easily and quickly be taken down or put up.

Make your spars out of the same stuff as your masts, and do not let them be too thick and so look heavy, but at the same time they must not be too thin so as to be weak. Your own judgment must guide you in this. When nicely sand-papered up they should have a coat of varnish.

To ship your mast, get a piece of brass tubing of the same diameter as the lower end of the mast, and long enough to reach down to the bottom of your boat and to project $\frac{1}{2}$ inch above the deck, and plug up one end of it with a piece of hard wood. Then, having determined the position of your mast in the bottom of the boat, not forgetting to allow for the "rake" (or inclination), fasten a small chock of wood there, and drill a hole in it just large enough to admit the lower end of the brass tube, which should be passed through the deck and fit tightly. Cut away the lower end of your mast, as shown in Fig. 17, and drop it into the tube, having previously put a flattened out curtain

ring between the collar left on the mast and the tube. The object of this you will see further on.

In this way you obviate any chance of water coming in through the mast hole, and have not the nuisance of fumbling about for the said hole in the bottom of the boat when putting the mast in place. An indiarubber ring may be put round the tube on the deck, by the by.

The bowsprit must next be shipped. This spar should be made flat where it lies on the deck, and the end should fit into a brass cap or a block of wood screwed to the deck, and a band of metal should pass over it near the stem-post, also screwed to the deck. As the deck is rather thin, you will find it advisable to fix little pieces of wood underneath it in all places where screws are put in. So now you see why the deck should be fastened down last of all.

Having got all your spars ready, and the mast, or masts, and bowsprit in place, you can begin the ropes. Get some good whipcord, and see that it consists of three strands. You will want various thicknesses as you will see presently; so get some fairly thick stuff, and then some very fine cord, and some a bit thicker than the latter. Use the thickest for the backstays (Fig. 14). To fix these, screw some few inches abaft the mast on the sides of the deck two "screw eyes," and fasten two, one on each side, into the mast just below the ferrule, or better still, right through the ferrule, about one-third way up it and into the mast. Now get some brass wire and make a few hooks, as shown in Fig. 18. Take one of these, and having cut the length of your backstay about six inches longer than necessary, splice one end into the eye. If you do not know how to splice, I should advise you to get some one to show you; or if you can't do that, you must knot all the things instead of splicing, though the latter looks a thousand times neater. Pass the other end of the stay through a double eye, as shown in Fig. 19, and having put another hook on the cord, splice the loose end on to the lower eye of the double eye. Then fix the two hooks, one to the mast and the other to the deck, through the "screw eyes," and tighten by pushing up the running eye or double one. These double-ended eyes for tightening up the stays or any rope in models that require to be lengthened or shortened a little are termed "slides."

The next stay to be set up is the bob-stay. This, though, should be made of picture wire, as the ordinary cord would shrink too much with the wet, as it is so often under water, and should be of such a length that by bending the bowsprit down a little you can hook it on to an eye made of wire fastened round the end of the bowsprit, the other end being hooked into an eye screwed into the stem-post a little above the water-line.

These are all the stays that can be fixed up at present, in fact, they are the only ones that are fixed, so to speak, the other two, or one, as the case may be, moving with the fore-sails. But you will see this presently when you have sewn your sails, which is the next job. For these get some jaconet, or very fine long cloth, because you must have them as light as possible. Dip your stuff in boiling water before using it, and let it lie there for some hours, then take it out and stretch it on the floor, nailing it down at each *end*, not along the selvedge, and in this position let it dry. When you take it up there should not be a crease or pucker in it.

Now carefully mark out the sails on it, taking care that the "after leach" of every sail be along the selvedge, and cut them out, leaving about three-quarters of an inch round each sail for hemming. If you can sew yourself, hem the sails up to the line marked, if not, get some one to do it for you that can, but in any case it must *not* be done with a sewing-machine, because, as you would afterwards find out to your cost, the sewing-machine stretches them dreadfully, and they never "stand" properly, there being always a lot of creases and puckers round the head and foot of each sail. So never mind the little extra trouble, but sew them by hand.

In cutting out the sails the head should always be rounded, and the foot the same, more especially in lug-sails. The "luff" of the sail should be cut just a trifle hollow.

In larger sails it is necessary to sew tape along all the edges, over the hemming (except, of course, along the after leach), as the strain on the sails would tend to stretch them materially out of shape.

When your sails are all sewn, iron them over carefully, and then you can think about "bending" them.

First let us begin with a "gaff-sail," that is to say, one like a cutter's or schooner's main-sail. You have, of course, got your boom and gaff cut to the right length, so to the end of the former fasten a strip of metal, about three-sixteenths of an inch wide, with small screws, as shown in Fig. 20, having previously slipped a curtain ring, bent as shown in Fig. 21, and large enough to fit easily on to the brass tube in the deck, into the bend of the metal strip. Now with some fairly stout wire make some "jaws" to the gaff (Fig. 22), and bind them on with fine binding wire, leaving them open enough to allow of their being "sprung" easily round the mast.

Then sew rings to the luff of the sail large enough to slip easily over the mast, and at distances of about a couple of inches from one another. Slip the ring on the boom over the tube in the deck, put the mast in place (not forgetting the flattened ring), then put the rings on the sail over the mast, and slip the jaws

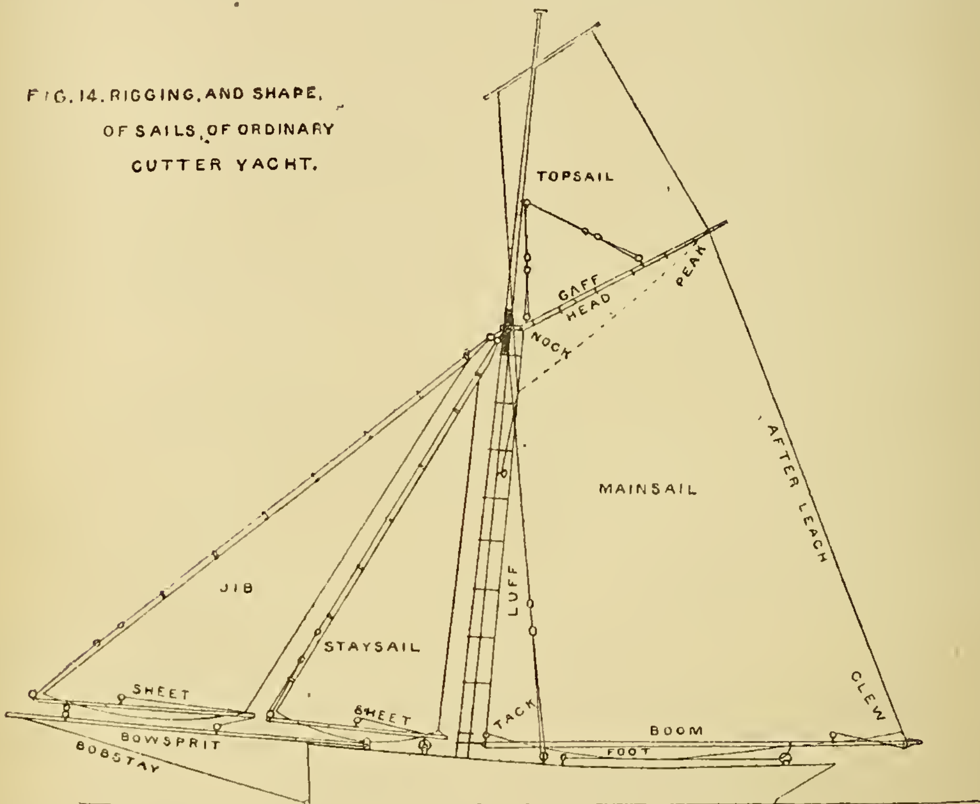
of the gaff on. The gaff, by the bye, should have been laced to the head of the sail, the latter being well stretched. Now fasten the tack of the sail down to the boom by passing a piece of fine whipcord through the strip of metal on the end of it, and through a small hole in the sail, and tying but not too tightly.

For the clew fasten a piece of whipcord to the corner of the sail, and having passed it through a hole near the end of the boom, fasten the loose end to a pin of wire, Fig. 23, and pin to the underside of the boom.

fasten a wire eye round it, and tie this down to its corresponding place on the bowsprit. In this way the leach of the sail is always kept stretched, and the more you tighten up the stay the more you stretch the sail (Fig. 14).

For a lugsail you lash the head of the sail to the gaff, and the tack to the fore end of the boom and pull out the clew as before. The mast being stepped in the same way as for a gaff-sail you have simply to fasten a ring to the boom at about one-third from the fore end and the same on the gaff, and pass the former

FIG. 14. RIGGING, AND SHAPE, OF SAILS, OF ORDINARY CUTTER YACHT.



Now fix the throat and peak halliards in the same way as the stays, to "screw eyes" in the gaff, and the mast, tighten them up and your sail will be bent.

To bend a jib or foresail make a boom for it, and at one end of the boom make an eye of wire. Into this hook a stay prepared in the same manner as the backstays, the other end being hooked into the corner of the sail, and with another hook into a screw-eye in the mast through the ferrule. Now fasten the tack of the sail down to the eye on the boom, and with small wire-rings fasten the luff to the stay and haul the clew tight in the same way as the gaff-sail. Now at about two inches from the fore-end of the boom over the tube in the deck and the latter over the mast. The flattened ring will hold the boom down, and allow it at the same time to turn easily. The gaff should be tightened up with a "slide" to a screw eye a little way above it in the mast.

Topsails are swung as lugsails, the clew being fixed to the end of the gaff and the tack pinned to the mast.

I have not said anything about the "sheet" yet. This should be fixed as near the end of the boom as practicable, and made to work through a ring running on a "horse," and then pinned to the deck. Most pin the sheet to the boom, but it weakens the boom

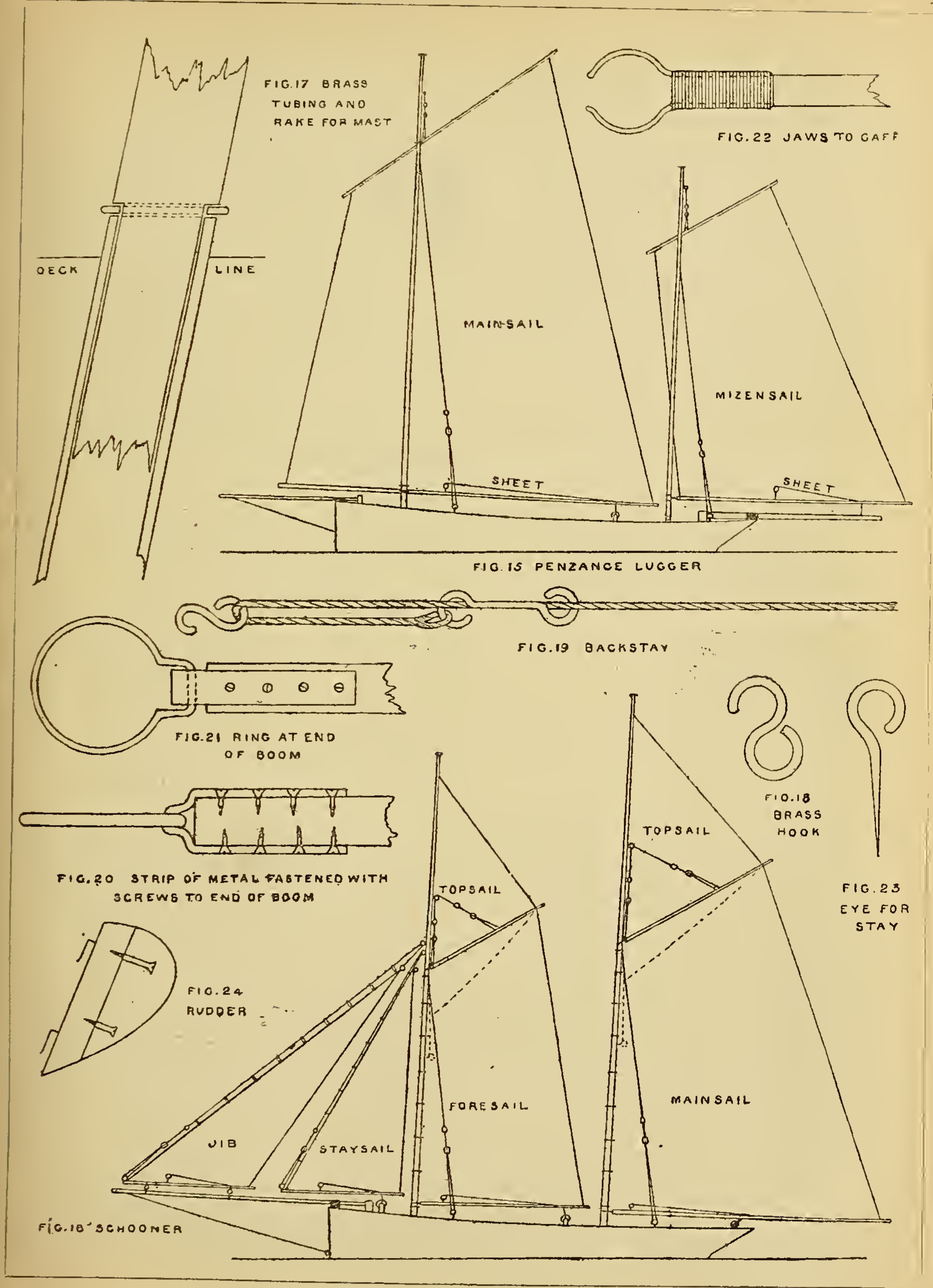


FIG. 17 BRASS TUBING AND RAKE FOR MAST
DECK LINE
MAINSAIL
MIZENSAIL
SHEET
SHEET
FIG. 22 JAWS TO GAFF
FIG. 15 PENZANCE LUGGER
FIG. 19 BACKSTAY
FIG. 21 RING AT END OF BOOM
FIG. 18 BRASS HOOK
FIG. 20 STRIP OF METAL FASTENED WITH SCREWS TO END OF BOOM
TOPSAIL
TOPSAIL
FIG. 23 EYE FOR STAY
FIG. 24 RUDDER
FORESAIL
MAINSAIL
JIB
STAYSAIL
FIG. 16 SCHOONER

very much, and, besides, it is much easier to get at the deck.

A "horse" is merely a piece of stout wire bent in the form of an arch, and screwed across the deck, the one for the mainsail being as near the end of the counter as practicable, and the one for the foresail between the mast and end of the bowsprit.

I think you have enough instructions here for rigging a model thoroughly, and I will, just to finish my papers, give you a hint or two for sailing.

When you first try her, make her go to windward, *i.e.*, in the direction from which the wind comes. For this pull the sails in to a small angle with the centre line of the deck and let her go. If she comes up into the wind and shakes, you must either tighten in the head sheet "or loose the after sheet," if she falls away from the wind do *vice versa*.

For "reaching," that is with the wind at right angles to the direction in which you want the boat to go, let all the sails out to about 45°, and then treat her the same, if she comes up, or falls off, as for going to windward.

For a "quartering" wind let the sails out at rather more of an angle than for "reaching," and for "running" put on a rudder (Fig. 24), and let out the mainsail if a cutter on one side at right angles to the boat, and the mainsail on one side and the mizen on the other if a schooner or lugger, and flatten the head sails down well and let her go.

Last, but not least, comes the rudder. As you will have seen from the above, I only use one, and that is running, and this one cannot be too heavy, in moderation of course. It is made as follows :—

Take a strip of wood about 1 inch shorter than the stern-post, and of the same thickness and about 1 inch wide. Screw into it two screws (Fig. 24), and then having made a mould to something of the shape place this piece of wood in it, and pour lead into the other part of the mould, so that the melted lead may run round the screws and against the wood. Trim this up afterwards nicely and you will have your rudder, which should be fixed by two pieces of wire bent at right angles and driven into the wooden part of it, dropping into two screw eyes in the stern-post.

One little thing I should like to mention before I bid adieu to my readers, and that is to put a strip of brass all along the bottom of the boat ; they will find this saves the paint being scratched, and prevents the lead getting knocked about.

I hope the outcome of these papers will afford many hours' amusement to some readers. To those who may at any time find any difficulty in miniature yacht building, I may say that I shall have great pleasure in answering any questions that may be put to me through the medium of "Amateurs in Council."

CLOCK CLEANING AND REPAIRING AT HOME.

By OLLA PODRIDA.

II.—CLEANING AND RESTORING.

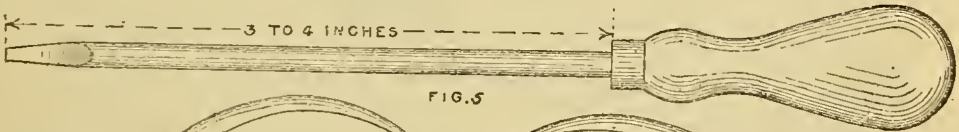
FOR convenience in description, we will assume that the clock described in the preceding chapter has become dirty and requires a thorough overhauling and cleansing. To carry this out the works must be removed from the case and carefully taken to pieces. The tools necessary to the accomplishment of this are few in number, and of simple nature. A small screw-driver, shown in Fig. 5 ; a pair of pliers, shown in Fig. 6 ; and a pair of pincers of the form given in Fig. 7. The use of the screw-driver will be obvious ; the pliers are for enabling small pins, etc., to be withdrawn ; the pincers, or rather nippers, are for cutting wire as required for new pins. Nipping, side-cutting, or bell-hanger's pliers are not so suitable as the nippers shown in Fig. 7. Sometimes, in order to facilitate the removal of pins, the ends have to be cut off in place, which, for obvious reasons, could not be accomplished with side-cutting pliers.

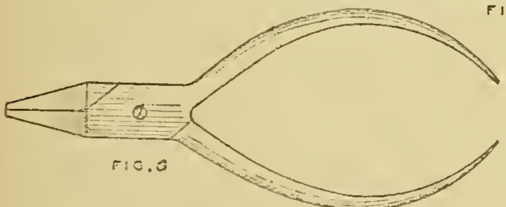
The screw-driver may be readily made out of a piece of steel wire, say about $\frac{3}{16}$ inch in diameter, one end being flattened to suit small screws, and the other squared and pointed to receive the handle. The pliers may be obtained for 6d. at any ironmonger's shop, and quite good enough for the purpose. The pincers, or nippers, may be had for about 1s. 6d. Assuming that the amateur is already provided with these necessaries, we will proceed to work.

The first thing to be done is the unhooking of the pendulum bob. Do this *before* moving the clock from its position. This precaution must be taken, otherwise you will run the risk of bending or, at least, straining the "feather," or thin portion of the pendulum rod. Next remove the hands. The minute one is fitted on the squared end of centre spindle, and is secured and steadied by one or more "collets," or washers and a pin. A word here on the withdrawal of such and other pins. Treat them gently with a coaxing, twisting motion, and not as refractory corks. The hour hand is fitted on, and carried by the hour wheel "pipe," and being only lightly held by friction, may easily be removed. The dial plate comes off next. It is generally fastened by screws, tacks, or small bent pins. In either case circumstances will suggest the best and readiest means of removal. The works may now be removed bodily from the case to which they are secured by means of small screws passing through lugs on the back plate or portion of frame into the back of clock case.

The operation of taking to pieces may now be commenced in real earnest, and assistance will be derived from reference to Fig. 3 (see page 109), which is a front view of the works complete. The natural result of moving the pendulum rod and pallets would be the "running down" of the works, and with that the expansion or uncoiling of the mainspring to its full limit in the framework. It would in this uncoiled condition prove very troublesome in restoring, or "rehabilitating" the works. Precautions must therefore be taken in time so as to avoid such a contingency, and these precautions are as follows: Before removing the pendulum rod, or pallets, the spring must be wound up tightly and secured in that state. There are two ways of "fixing" the spring. One method consists in binding it with fine wire. But it is not often very practicable to bind it in such a manner, neither is it safe unless backed by experience, as the writer can testify. There is a lot of mischief wrapped up in even a small spring when tightly wound up, and if, when lying among other loose members of the works, it manages to suddenly regain its freedom, there will be "trubble," and a bad time for the amateur in hunting up the missing "links."

The surest and safest means of securing the spring will be found in the clamp shown at Fig. 4. To make such an appliance, stout iron wire, say about $\frac{3}{16}$ inch or $\frac{1}{4}$ inch in diameter, must be employed. The wire need not be round; square, in fact, would be more suitable. The wire should encompass as much as possible of the spring, and be made an easy fit upon it when wound up tightly, so that by allowing the clock to run the spring may expand inside of the clamp, and thereby hold itself, so to speak. By so doing a small margin is left, allowing the spring to be wound up, and the clamp slackened when the works have been restored. A serviceable clamp may be manufactured out of a large spike nail, the head being first filed off. A similar but smaller appliance will be required for the alarum spring.





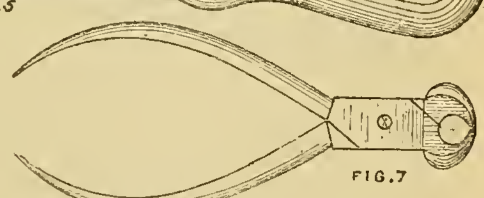


FIG. 5.—SCREWDRIVER FOR CLOCK REPAIRING, ETC. FIG. 6.—PLIERS. FIG. 7.—NIPPERS.

Trusting that the clamp business has been thoroughly understood, we will assume that the springs have been properly secured, and proceed with the dissection. Remove the pendulum rod, taking great care not to bend or damage the "feather" end, which hangs through the slit in the pin, or "cock," at *a*. It will probably be found necessary to open the slit a little before the "feather" can be removed. The requisite freedom may be given or obtained by inserting the blade of a penknife into the slit, and giving a slight twist.

The "pallets" and "crutch" occupy our next attention. The "pallets"—lettered so in Fig. 3 of illustrations with first part—embrace part of the escape wheel, and control or effect the regular release of the teeth, each hooked or bent part forming a pallet or rest for the teeth during their intermittent motion in escaping. The "crutch," marked B in Fig. 3, consists of a wire riveted to the back of the "pallets," and extending down below the "cock," or support for the pendulum rod, where it terminates in an eye, which embraces the latter.

The pallets and crutch are carried by and vibrate upon a stud or pin, which is riveted into the front plate of clock frame. To keep them from slipping off this stud, a spring made of wire, in the form of a bent arm, is employed. This safeguard is shown at C. It is flattened at the outer end, where it rests on the stud, so as to form a cheek or collar for the pallets to work against. The other end passes through the front plate, and is bent or clenched on the inside for security. Before the pallets can be removed, this spring must be slightly raised and turned partly round so as to be out of the way. In removing the pallets, care must be taken to avoid bruising of the escape wheel teeth. Being very thin and delicate, this may easily be done through neglect or carelessness, and is most likely to occur if any "go" is left in the main-spring.

On the left-hand side at D, D, two star wheels will

be observed. The upper one of these wheels is fitted on the square end of alarum spring spindle, and is secured by means of a small pin passing through the spindle, and bent at the ends to prevent it from dropping or working out. The other star wheel, the lower one, runs on and is carried by a rivet or stud fixed in the frame ; this wheel need not be removed, there being no necessity.

These star wheels serve the same purpose as the Geneva stop in watch work and the better class of spring clocks—namely, to prevent the spring from being over-wound and running down too low. But in this case the purpose for which these wheels are used is to limit the action of the alarum, or duration of "row." An examination of the teeth will throw more and better light upon their action. The upper one has six teeth, one of them being longer than the others. The lower one has seven spaces, two of which are shallower than the others. The long tooth in the upper one, by jamming or striking against the bottom of the shallow spaces in the lower one, confines the alarum spring spindle to a certain number of revolutions. This will be more easily ascertained and clearly understood by actual experiment. Before removing the upper star it will be safest to note or mark its relation to the spindle and lower wheel. This will avoid trouble, and ensure its being correctly replaced.

The upper star having been removed by pulling the pin out of the spindle, the next thing is to remove the pins at E, E, which secure the front plate. If these pins cannot be straightened and pulled out by means of the pliers, one end of each must be nipped off. These pins having been withdrawn, the front part of the frame will be freed and may now be removed. In doing this, lift it off quietly so as not to risk scattering of the gear all over the shop. The front end of escape wheel spindle being carried by a bracket or arm, which is riveted on the front side of frame plate, and the escape wheel itself being placed between this bracket and the frame, it will therefore be necessary to remove it separately or individually from the front plate of the frame. It will probably be found to be a snug fit between these parts, in which case it will be necessary to "spring" or press the bracket slightly away from the front plate before the end of the spindle will clear from the hole. In doing this, if it is found necessary, care must be taken not to permanently bend the bracket, as in that event, if it occurred unnoticed, undue lateral "play" would be given to the escape wheel, whereby its teetb would be liable to suffer damage should it slide or get out of line with the pallets, and "race" into or rather against them.

The "going" spring on the right-hand side of the frame must be slipped off the pillar beneath, it being connected to this pillar by means of an eye or hook formed at the outer end of the spring. The strain of winding is thus taken by the pillar. The alarum spring is held in a similar manner. All the rest of the works will drop out easily.

We are now ready for cleaning the various parts. Space will not permit of this being entered upon in the present chapter. In the next it will be fully treated upon, and different ways of accomplishing it described.

(*To be continued.*)

GLASS-BLOWING FOR AMATEURS.

By ALFRED W. SOWARD.

IV.—ACTUAL WORK.

THE simplest glass-blowing operation which can be performed is the rounding of a cut end of a piece of glass rod. A clear and steady flame is produced, and the rod for the length of about an inch from the cut end is warmed in the hot air beyond the flame. It is then caused to gradually approach the flame until the latter touches it at about the eighth of an inch from its end. During the whole of this time, and during the subsequent part of the operation, the rod is caused to rotate on its axis, so that it may be equally heated on all sides. The heat soon spreads from the point where the flame is applied to the extreme tip of the rod, and the sharp edges disappear. The rod is then removed from the flame to the hot air and is slowly cooled. The object of applying the greatest heat to a part of the rod at some little distance from the end, where the heat is required, is to prevent any chance of fracture. A cut end cracks very readily, and extreme care must therefore be used in the heating.

If the end of the glass rod is required to be pointed, it should, when quite soft, be touched with a piece of hot glass, which will adhere to it. The heat then being concentrated upon the part of the rod at about the eighth of an inch from the joint, the second piece of glass is drawn away, and carries witb it the top of the rod, leaving the rod itself terminated by a cone. This being exposed to heat becomes more and more rounded, and at the right moment the rod is removed from the flame and cooled. During the last heating the cone is kept uppermost, for tbe reason that hot glass is viscous, and that it is desirable that the semi-fluid glass should accumulate at the base of the cone, and not at its apex.

The cut ends of a piece of glass tube are smoothed in a similar way, but more caution must be used in

the heating, as the mass of glass being smaller the softening point is reached more quickly, and the danger of deformation is greater.

The next operation to be described is the bending of glass tube. For the first experiment, a piece of tube not exceeding a foot in length, and having a diameter of about half an inch with a thickness of glass of about one-twelfth of an inch, may be taken. It is warmed as before, and is then heated in the flame for a length sufficient to cover the intended bend. The tube is held with an end in the fingers of each hand, and the palms of the hands are directed upwards: the elbows may, until practice has given steadiness of arm, be supported by the table; but this is a habit which should be discarded as soon as possible, for so long as it is indulged in delicacy of manipulation cannot be attained to. As before, the work must be kept constantly rotating, and it should be exposed to the action of the under rather than of the upper part of the flame, so that the hottest part of the tube may be upwards and within view. In judging of the state of softness of the tube, attention must however be paid more to touch than to sight. Before the tube has become red hot, the fingers will find it to be soft, and if a tube of less diameter or thinner substance were selected for the first experiment, considerable difficulty would probably be experienced in preventing distortion. A delicate sense of touch must be cultivated, and constant attention must be paid to the correction from moment to moment of the tendency of the tube to deformation. When it is judged that the tube is sufficiently soft for bending, it is removed from the flame, and with a firm hand and steady motion, but without loss of time, it is bent into the desired shape. The part of the tube which leaves the flame last, and

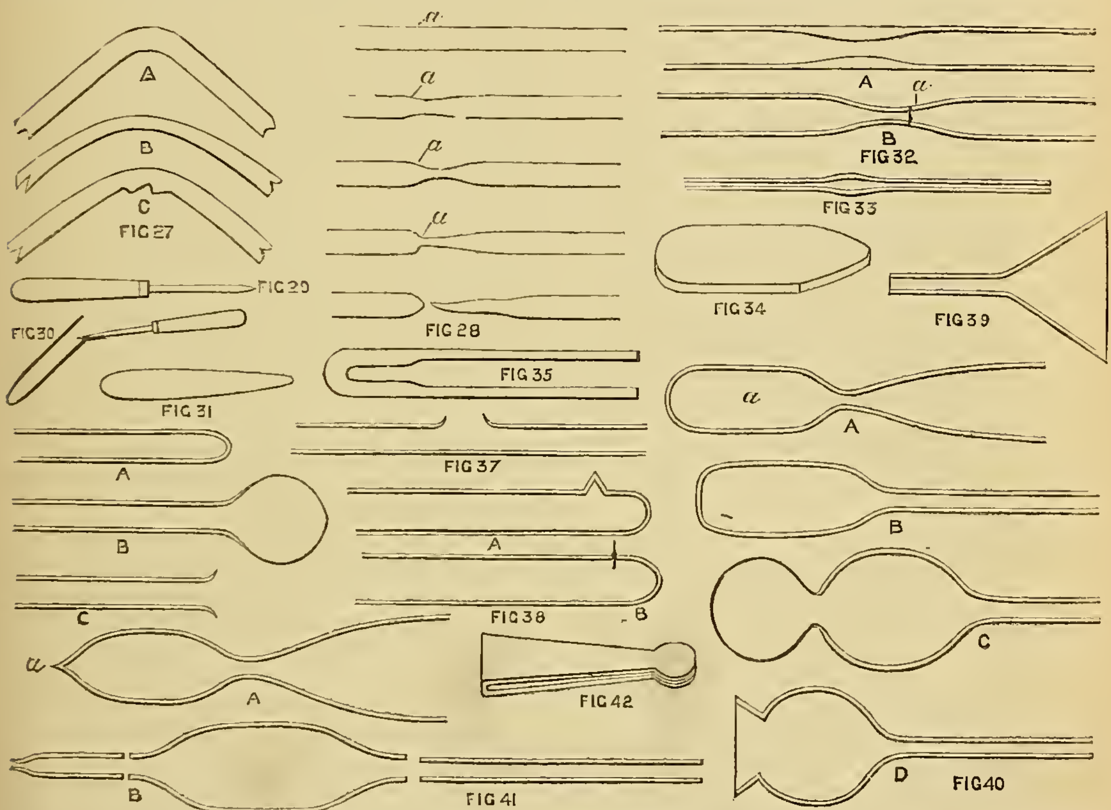


FIG. 27.—DIAGRAM ILLUSTRATING APPLICATION OF HEAT—A, Curve properly formed; B, C, Curves improperly formed. FIG. 28.—SUCCESSIVE CHANGES IN FORM OF TUBE UNDER ACTION OF BLOWPIPE, AFTER FARADAY—A, Point of application of flame. FIG. 29.—TOOL FOR FORMING RIM TO TUBE. FIG. 30.—ACTION OF TOOL. FIG. 31.—IRON CONE FOR FORMING RIM. FIG. 32.—DRAWING TUBE TO CAPILLARY TERMINATION. FIG. 33.—BULGE AND SEPARATION OF PORTIONS OF CAPILLARY TUBE. FIG. 34.—IRON PLATE USED IN BLOWING BULBS. FIG. 35.—END OF TUBE THICKENED FOR BULB. FIG. 36.—BULB BLOWING—A, End of Tube sealed; B, Tube with Bulb; C, Tube with Bulb broken off. FIG. 37.—JOINING TUBES AT AN ANGLE. FIG. 38.—SEALING PLATINUM WIRE IN TUBE—A, Preparation of Tube; B, Completion. FIG. 39.—SMALL FUNNEL. FIG. 40.—MANUFACTURE OF THISTLE FUNNEL. FIG. 41.—MODE OF MAKING A PIPETTE. FIG. 42.—TONGS FOR FLATTENING TUBES.

which is presumably the hottest, should be allowed to become the convex portion of the bend.

The great error to be avoided in this operation is making one side of the tube much hotter than the other. If the latter be done, the bend, instead of assuming the regular curve shown at A, Fig. 27, will have its convex surface flattened, as at B, or its concave surface gathered into puckers, as at C, according as the unduly hot, and therefore soft, part of the glass is above or below. Another error to be avoided is getting the arms of the tube on the opposite sides of the bend into different planes.

If the bend is through a very large angle, and a sufficient length of tube for the whole bend cannot be heated at once, then the bend must be made in a number of successive operations, the whole process being made as continuous as possible, so that the heating which softens one part of the tube for bending may also give the preliminary warming to the part adjacent, which is next to be bent.

When the bend has been completed, the tube should be annealed in the roaring flame and in the zone of hot air, and should then be laid aside to cool in such a position that the hot portion is in contact with air only. An additional precaution worth taking when the tube is massive is to cover the work with paper or cloth, whereby the cooling process is made slower.

If a tube has to be bent near one of its extremities, it will be found impossible to use the fingers to that extremity owing to its high temperature. A piece of wood may then be inserted into the tube, and this be held in the hand. Sometimes, however, the bend has to be carried to the very end of the tube, and then recourse must be had to a piece of cold metal. So long as the metal is cold and the glass is soft, there will be no danger of fracture of the latter; but if the glass should be hard, it will be cracked, or if the metal should be hot and the glass hard, the two will adhere. They must therefore only be brought into contact at the moment of bending the tube.

The next operation, and one of somewhat greater difficulty than any of those already described, is the preparation of a tube closed at one end. A tube is taken of about the size of that used in the last experiment, and the blow-pipe flame is directed upon it in such a way as to heat a narrow ring in the centre of the tube. When the glass is sufficiently soft, the hands are slowly moved away from one another, and the tube passes through the changes of form represented in Fig. 28. As the tube becomes thinner through extension, it is carried into a part of the flame less hot, and at the same time the pulling force upon its ends is lessened. If this be not done, the tube will almost certainly separate into two short tubes, having thin and jagged ends. It will be seen on reference to the diagram (Fig. 28) that two closed tubes have now been produced, the one having a fairly rounded bottom, and the other terminating in an irregular cone. In the centre of the bottom of the first will probably be found a little knob of glass. To remove the knob, and to make the bottom perfectly round, the closed end of the tube is again heated, and when it is quite soft the open end of the tube is placed between the lips, and air is gently blown in. If the knob is so large as not to be removable in this way, it must, when the end of the tube is soft, be touched with a piece of heated glass, and be drawn off. The other closed tube has now to be finished, and to do so requires somewhat more skill. The conical end is softened, and is touched with a piece of hot glass, which adheres to it. The flame is then caused to play upon the cone at a part slightly removed from its base, and presently, when the glass is sufficiently soft, the apex of the cone is drawn off, and a second closed tube with rounded bottom is obtained.

If on examination it should be found that the bottom of the tube is either thicker or thinner than the sides, it and the whole lower part of the tube must be heated to softening, when the glass will flow either from the bottom to the sides, or from the sides to the bottom, according as the open end of the tube is held downwards or upwards.

When a piece of tube has to be sealed at its extremity, the end to be closed is heated, and when soft, is pressed in upon itself with a piece of cold iron. The tube having been thus roughly closed, a piece of hot glass is attached to the sealed end, and the flame being applied to the part just above the point of attachment, the portion below the point of application of the flame is drawn off, and a rounded bottom is obtained, which is finished as before.

The open end of the tube formed by either of the preceding processes should be heated in the flame until the sharp edges disappear, and, to prevent any chance of fracture, the greatest heat should, as has already been explained, not be applied to the cut edge. If a rim is required to the tube, it can readily be formed while the glass is soft by the aid of the tool represented in Fig. 29, which is merely an iron rod fixed in a handle. The method of using it is shown in Fig. 30. A lip may be formed by a slight additional pressure at one part of the yet soft rim. For similar work on a larger scale, the iron cone represented in Fig. 31 will be found useful.

If a tube is required to be drawn out to a capillary termination, the portion to be operated upon is thickened, as at A, in Fig. 32, by gently pressing the hands towards one another while the glass is soft; the hands then being slowly drawn apart, the tube

appears as at B, and is cut witb a file at the point A. The capillary termination is tben placed for a moment or so in the flame to smooth the cut edge.

In the preparation of a considerable length of capillary tubing, a piece of glass tube of small bore, but of good thickness of material, is heated in the flame until about an inch or more is quite soft. The tube is then removed from the flame, and the hands are withdrawn from one another at the rate of about a foot a second. If a greater length of tube is required than can be prepared at one operation, the part of the tube adjacent to that previously heated is afterwards heated, and when soft is drawn out. The two portions of capillary tube so formed will generally be separated by a small bulge, as in Fig. 33, but the bulge is readily removable by gentle beating and pulling.

The next operation calling for description is the blowing of bulbs. A piece of tube is selected of about a foot in length, one-tenth ot an inch in bore, and tbe same in thickness of glass. The end having been closed, the bottom inch of the tube is heated to a bright cherry red, or until the glass is so fluid that the heated end bends over of its own accord. The work is then removed from the flame, and, without any delay, a carefully regulated stream of air from the mouth is directed down the tube into the bulb, the tube being caused to rotate rapidly on its axis the while. The heated portion gradually expands into a bulb, and as it expands and becomes thinner, the force of the stream of air is diminisbed. It will probably be found necessary, owing to the rapid cooling of the glass, to re-heat the partially-blown bulb, and to complete the blowing in a second operation.

If the glass tube is so thin that it is impossible to blow a bulb from it having sufficient thickness to be of use, tbe end of the tube must be thickened before the blowing is commenced. The tube baving been closed, and softened in the flame, tbe hot end is pressed against a piece of cold metal (the iron plate, Fig. 34, is sold for the purpose) ; with a little dexterity the tube is made to assume the shape shown in Fig. 35, and the bulb is then blown as before directed.

A bulb is blown in the middle of a tube in a very similar way. The part of the tube where the bulb is equired is softened, and is then thickened by the movement towards one another of the hands. One end of the tube, if both ends are open, is then closed with a cork, or even with a finger, and the bulb is blown.

Another operation constantly requiring to be performed is the joining together of glass-tubes, or of glass tubes and bulbs. Let the simplest case be taken first—tbat in which two straight tubes of equal bore and diameter, and with square cut ends, are to be joined end to end. The two tubes are softened in the flame, and are then brought into contact and firmly pressed together. They will adhere, and a thickening of the glass will occur at the junction, which must be reduced by gently pulling the ends of the tube. If the bore of the tube should be found to have become diminished in size, then, while the glass is soft, a gentle stream of air must be blown into the tube. In some cases it is advisable, before making the joint, to expand the ends which are to be fused together. This may be done by the aid of the iron rod (Fig. 29) before referred to, or by closing the ends of the tubes, and when the glass is very hot and soft blowing thin bulbs by a powerful blast of air. The bulbs being broken off, the ends of the tubes are left expanded, as at C, in Fig. 36.

Sometimes a tube has to be joined to another at an angle, and the way to proceed is as follows : One tube is corked at an end, and the tip of the flame is directed upon the spot where the second tube is to be attached. When the heated spot is quite soft, a strong stream of air is directed into the tube, and a thin bulb is blown, which, being broken away, leaves a hole in the side of the tube bordered by a projecting lip, as in Fig. 37. To this lip, while hot and soft, the soft end of the second tube is attached, and the two unite. The junction is heated strongly, and the glass there is slightly extended by pulling and by blowing into the tube. A joint is so formed, which, if slowly cooled, will not crack.

An operation, which very often has to be performed in the laboratory, is the sealing of a platinum wire into a glass tube, as, for example, in the construction of an eudiometer. The part of the tube where the wire is to be inserted is softened with the tip of the flame, and a piece of platinum wire is then pressed into the soft glass until its point has penetrated the glass: the wire is then drawn out, and the glass will be found to adhere to it, and to be dragged into a little hollow cone on the outside of the tube, as shown at A, in Fig. 38. If the wire has not been withdrawn too quickly the cone will be short, and thick in the sides, which is the form that it should assume. The apex of the cone is filed off, and any glass adhering to the wire is detached. The latter is then inserted into the hole in the cone in nearly the position it is intended to occupy. Tbe flame is next applied to the junction, and tbe glass softens and collapses upon the wire, which, being then gently pressed inwards, the cone disappears, and the operation is complete. The tube now has the appearance shown at B.

Small funnels are readily made. A tube of a diameter suitable for the stem of the funnel is selected and closed at one end, and the closed end is thickened

and blown into a bulb. The part of the bulb opposite to the tube is then, when hard but still hot, touched with some cold object, a wet finger, for example, and is thereby cracked. The bulb is again heated—the cracked portion very intensely, the portion adjoining the tube less strongly, and the intermediate parts of the bulb to degrees of heat corresponding to their positions. The heated bulb is removed from the flame, and caused to rotate rapidly on its axis, when the bulb will open at the crack, and will expand into a funnel, as in Fig. 39.

All the ordinary operations of glass-blowing likely to be performed by the amateur have, it is thought, now been described. Much apparently difficult work of the glass-blower is to be seen in the instrument maker's window, but if carefully examined it will almost invariably be found to be, in reality, very simple. As a house is built of a multitude of bricks cast in very few moulds, and as our most varied thoughts are conveyed in writing by the aid of hardly more than a score of signs, so the most wonderful product of the glass-blower's art results from the skilful combination of a few simple operations. It would be impossible in the space here at command to enter very fully into architectural glass-blowing (if the term may be used), but in support of what has been said a few simple illustrations will be taken.

Let the making of a thistle funnel be first considered. Two pieces of glass tube are selected, the one with a bore of about one-eighth of an inch for the long stem, the other with a bore of about three-eighths of an inch for the bowl. The stout piece is closed at one end, and the part distant about an inch from the closed end is softened and drawn out until its diameter has been reduced to that of the small tube. The flask-shaped portion, A, Fig. 40, is then severed from the remainder of the tube with a file, and is next fused to the stem, as B. The flask is now softened in the flame, and blown into a bulb, and the flame being then directed upon the point of the bulb opposite to the stem, a very thin second bulb is formed by a strong blast of air, as C. This second bulb being broken away, a roughly-formed funnel results; and the bulb being again heated, and the edge turned over with the iron rod (Fig. 29), a well-shaped thistle funnel is obtained, as at D.

To make a pipette the process is very similar. The only points of difference are, that the large tube instead of being closed at one end with a rounded bottom, is closed in the way shown in A, in Fig. 41, and that the thin second bulb is formed on the point A, and when broken away leaves a small projecting tube, as in B, to which a second stem, drawn to a capillary termination is attached.

In conclusion. — Success in this art depends, perhaps, more than in many other arts, upon the mastering of details. The operator should practise upon odd pieces of glass until he is perfectly familiar with the nature of the flame, until he is able with ease to perform all the simple operations described, and until glass has become almost as plastic in his hands as clay in the hands of the potter.

The prices of the tools and other articles mentioned in these papers are as under :—

		s.	d.
Mouth blow-pipe, of japanned tin plate		0	8
Mouth blow-pipe, of brass, with bone mouthpiece		1	6
Bunsen burner and blow-pipe jet		2	0
Glass-blower's lamp		4	6
Herapath gas blow-pipe		6	0
Fletcher's automaton gas blow-pipe	10s. to	15	0
Fletcher's double concentric gas blow-pipe		40	0
Fletcher's foot blowers	21s. to	36	0
Tilley's water blower		15	0
Glass-blower's tools (iron rod in handle, iron cone, flat iron plate, tongs for flattening tubes, Fig. 42), the set		2	6
Glass tube and rod, per pound, from		1	0

Errata.—The name of the inventor of the patent blowpipe described in the second article is "Gimingham," and not "Groningham," as printed; and in the description of Fig. 25, in the third article, "silver valve" should be "silk valve."

AN OPEN RECESS CABINET BOOKCASE.

By C. T. S.

FOR the benefit of amateurs who, like the writer, are not highly skilled cabinet-makers, but who yet take pleasure in working the softer woods, the following instructions, gathered from a recent successful personal experience, for making a black and gold recess cabinet or bookcase may be of useful interest.

This bookcase as described, is specially suitable for the recesses on each side of a drawing-room chimney abutment, but is, of course, adaptable for any similar recess. If for a drawing-room it should be fixed so that the top will be on a level with the mantelboard, and form a cabinet top for china or other ornaments.

The carcase may be made of two long shelves the exact length of the recess, and as broad, or nearly so, as the depth of it, and four uprights about 1 foot 2 inches long, and the same breadth as the shelves. Two of these uprights will form the ends, and the other two let in equidistant from each end, will divide

the book space into three equal divisions. The centre division, or, if desired, the whole three, may be divided by intermediate sbelves let into the uprights; but by dividing the centre division only, which will hold smaller books, the end divisions are then bigh enougb to hold music or other large books. If the depth of the recess is 10 inches or more, the intermediate shelf in the centre division need not come out witbin 4 inches or 5 inches of the front (*i.e.*, if the top and bottom sbelves are 10 inches broad, tbe intermediate centre sbelf need only be 5 inches broad), and this gives a pleasing cabinet effect.

Any suitable wood will do for tbe carcase that may suit the fancy of the amateur, but it is not necessary to go to tbe expense of walnut, cherry, or pear, the latter two of wbicb are the most suitable for ebonizing. For the following reasons yellow pine sbould be preferred: 1st, it is cbeap and easily worked; 2nd, it ebonizes or stains any colour sufficiently well for the purpose; the fronts or edges are covered with mouldings and cornice as described later on, while books and ornaments cover the shelves. The bookcase being made to fit a particular recess, will not be likely to fit any other without alteration, but in the event of moving into another house, the following details of construction will at least admit of its being altered to fit a smaller recess.

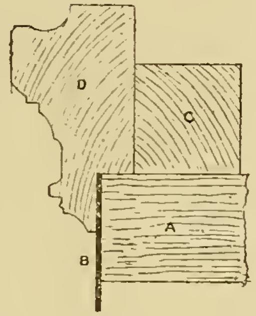


FIG. 2.—MODE OF FIXING MOULDING. — A, Upper Shelf; B, Leather Cloth; C, Fillet on Shelf; D, Moulding.

To construct a bookcase, say 4 feet by 1 foot by 1 foot 2 inches, procure a plank of yellow pine, well seasoned and free from knots, 15 feet by 1 foot by 1 inch, which will cost from 4s. to 5s. Get out and dress with the jack and trying planes two shelves 4 feet by 1 foot, and four uprights, two of tbem 1 foot 2 inches by 1 foot, and two 1 foot $2\frac{1}{2}$ inches by 1 foot. The shelves should now be tried to see if they will slip into the recess. If the bookcase is likely to be a permanency in the recess, the shelves should be dovetailed into the two end uprights, but if not, and what is more easily done (the above lengths of the uprights being given for this way), the ends of the uprights should be shot perfectly square and true on the shooting board till they are exactly 1 foot 2 inches long, and the shelves may then be screwed to them with $2\frac{1}{2}$ inch screws. In the case of removal, and in order to fit a smaller recess, this can easily be accomplished by removing the screws and cutting the shelves to fit the new recess, when they can be again screwed to the end uprights. The two centre uprights should now be rebated along the tops and bottoms to leave $\frac{1}{4}$ inch in feathers (the length of the two uprights 1 foot $2\frac{1}{2}$ inches provides for this), which should slip tightly into grooves cut across the two long shelves by a channel plane equally distant from each end, and the ornamental mouldings will eventually cover the joint. The small intermediate shelf between the two uprights may now be got out, about 1 foot 4 inches by 5 inches; it may also be feathered at the ends, and let into grooves in the uprights, or it may be supported by pins in the usual way of bookcase shelves. If the former way is adopted, the grooves in the two uprights must in this case be cut out with chisel and mallet, as the channel plane will not cut a groove half way across a board; the grooves and likewise the feathers on this shelf should not come within $\frac{1}{2}$ inch of the front of the edge so as not to show any joint, and the shelf must then be slipped into its place from behind. All the feathers and grooves may be cut with the chisel and mallet, quite as easily as with the rebate and channel planes, unless the amateur is an adept at their use. No provision is made for lining the back of the carcase, as this is quite foreign to an open drawing-room bookcase, if the wall paper is seen through in one or two places so much the

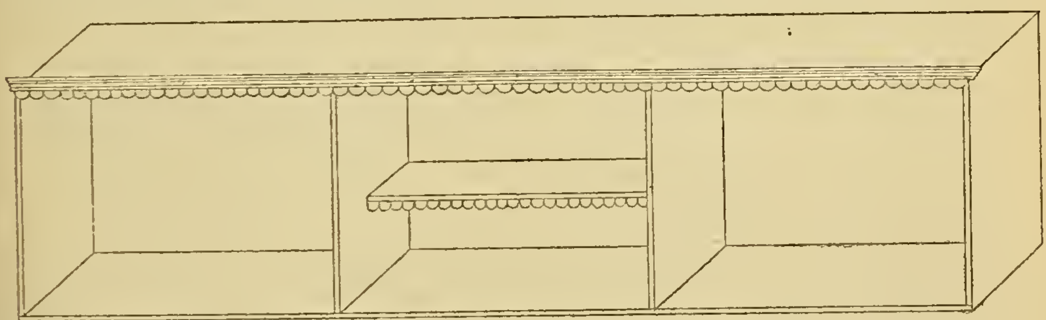


FIG. 1.—GENERAL VIEW OF OPEN RECESS CABINET BOOKCASE IN ISOMETRICAL PERSPECTIVE.

better. The various pieces must now get their final dressing with the smoothing plane finely set, and be well papered with No. 1 and No. 0 glass-paper, previous to being ebonized or stained, which must be done piece by piece before being put together.

Various ways of staining black to imitate ebony have been discussed in the correspondence columns of this magazine, and no doubt all are so far successful, but, with a soft wood like pine, the following process, which requires no French polishing afterwards, will be found most suitable, especially on large surfaces like the present piece of work. After having been well dressed and papered (and the better this work has been done, the better the final finish will be), the wood must be well cleared of dust, and rubbed all over with a coat of iron liquor (acetate of iron) applied with a cloth; by the time the last piece is finished, the piece which was first done will be ready for the second coat, which consists of an application of logwood liquor (extract of logwood dissolved in hot water, and applied in the same way with a cloth when tepid or cold). This will turn the surface of the wood jet black, and has, when dry, a dull sooty appearance, which must all be rubbed off or into the pores of the wood with a dry rubber. These three processes must all be repeated when on completion of the second dry rubbing, a dull black glaze or polish will be over the wood sufficient for the present piece of work. If a higher polish is desired, two or three further coats of the logwood liquor will completely fill up the pores of the wood, and with dry rubbings between each coat, will give a very good dull polish, but for highly finished cabinet work, the wood should now be French polished, and when hard, rubbed down with powdered bathbrick on a flannel damped with water.

The carcase may now be put together; the two shelves screwed to the end uprights, and the two centre uprights with their intermediate shelf glued and slipped into their respective grooves.

And now we come to the final and most important decoration of the as yet plain deal case. For this purpose, after gluing ornamental leather embossed with gold along the front edges of the top and small intermediate shelves, we employ the foreign picture frame mouldings in black and gold which are frequently advertised in the pages of this magazine, and some of which are very ornamental and of great variety. These are sold in 9 feet lengths, and two pieces, differing from one another in form, will be required, one for the cornice costing 2s. to 3s. should be about 2 inches broad, the rebate falling over the edge of the front of the top leather; to attach it to the bookcase it may be glued or screwed to a fillet about 1 inch square, which again, after being ebonized, may be glued or screwed on to the top of the upper shelf. For the front edges of the lower and intermediate shelves and the four uprights, a moulding costing 1s. to 2s. per piece of 9 feet will do, and its form must be flat on the front (*i.e.*, not bevelled), about $\frac{3}{4}$ inch wide; the rebate in this case must be all planed down or away till the moulding is only about $\frac{1}{4}$ inch thick. It must then be fitted to the various edges; the joints should be mitred at the two bottom corners, double mitred at the two bottom centre joints; and at the top of the four uprights, if there are gilt lines on the mouldings, the top cornice should be cut in, to let the gilt or other prominent lines on each moulding butt against the other. The form of the cornice moulding being larger and altogether different from the flat moulding, mitre joints between them are impossible. The various pieces of mouldings are now to be glued and clamped on to their places, and the bookcase is complete.

One or two further hints may be of use to the novice, although unnecessary to the expert. These ornamental mouldings can occasionally be bought without the rebate for picture framing, but even then they may be too thick and will require planing down. They are made with pine backing, with a composition on the face which is apt to chip, but with care they are easily cut and sawn, but this must always be done from the face, *i.e.*, cut the composition first. If rather wide for the shelves, they should be planed to the proper width on the shooting-board equally on each side till they fit, and the white planed edges should of course be ebonized before the mouldings are glued in their places. These mouldings are not sold in half pieces, so that half only of the cornice piece is used, unless a bookcase is made for each side of the chimney-piece. The bookcase should be supported in its place by fillets of wood 9 feet by 1 foot by $\frac{1}{2}$ inch nailed firmly to the wall at each end of the recess; and a hint as to the driving a nail into a brick wall may here be given. Take the finest sprig bit and put it into the plaster to find a joint between two layers of bricks. It may not be found at once, but it is bound to be found within $1\frac{1}{2}$ inch either above or below the first attempt; having found it, use $2\frac{1}{2}$ inch wire drawn or French nails, as they are sufficiently strong to bear any reasonable weight; the trial holes left by the sprig bit will never be noticed.

I may say that anyone who cares to follow out the foregoing instructions will find themselves in possession of a very beautiful piece of furniture, at a cost of little over half a guinea, and the highly finished appearance of which will no doubt surprise them, as it has already done the writer.

The judicious introduction of gilding to relieve the

otherwise monotonous appearance of a piece of furniture which is blackened or "ebonized" throughout, has a marvellous effect. It is not so necessary in articles of a lighter shade than black, such as dark oak, walnut, mahogany, and maple, or woods prepared to imitate any of these; but even when used in combination with these, the relief obtained is satisfactory to the eye, as will be at once conceded when we call to mind the common use of a gilt band intervening between the wood of the principal part of the frame and the white margin of the print in framing an engraving or any picture in black and white, sepia, chalk, pencil—or to take advantage of a term that will suit any or all of these means—in monochrome. And in the decoration of rooms, a band of gold intervening between the cornice and the paper or colouring of a room is highly effective as a finish, far more effective indeed than any border printed in colour, which looks heavy and obtrusive, not to say vulgar, when viewed in contrast with the gilt band.

To return, however, for a moment to the style of ornamentation for an open recess cabinet bookcase, that has been advocated and described in the previous remarks, it may be said that it is applicable to bookcases generally. For example, if a set of shelves be made in plain deal, the edges of the uprights that divide the shelves into compartments, and the edges of the shelves themselves, may be finished with flat black and gold mouldings, the mouldings for the shelves being fastened on over the leather. And these mouldings may be further used for the enrichment of doors, either within the mouldings that ordinarily surround the panels, or in place of them.

HANDY WOOD-WORKING TOOLS, AND HOW TO MAKE THEM.

By ARTHUR J. SCOTT.

IV.—TRAMMELS, RADIATORS, AND CHISEL HANDLES.

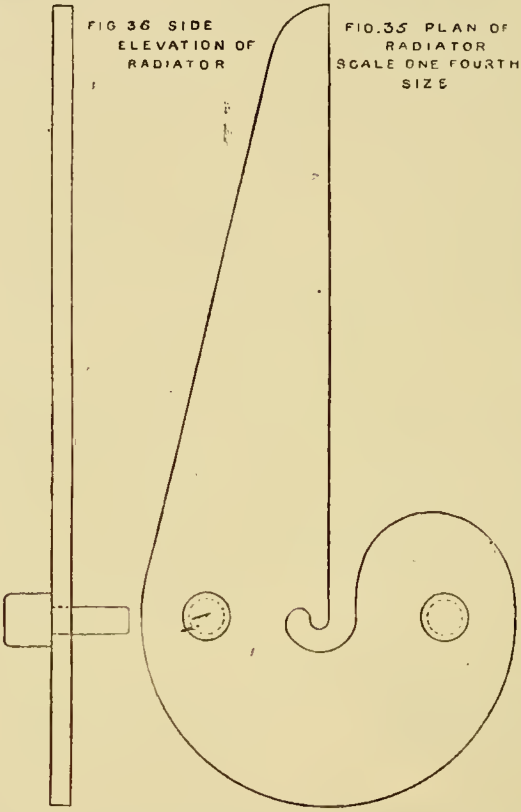
As I promised in my last article on tool making in this magazine, to supply descriptions of some handy trammels, I have very much pleasure in keeping that promise, and more so, because believing that any amateur who attempts the making of them need not be deterred by any difficulty in their construction, but will at the same time amply repay the amateur for any little extra trouble he would mind to put on them. I have endeavoured as far as possible to meet the desires of two classes of amateurs—one who will mostly have tools made out of metal by him, whilst another would rather have his tools of wood for lightness. On looking over back numbers I find on page 303 of the present volume some remarks as to the planes I describe in Part 36 by "Iota," and he concludes his short remarks by a very kind offer indeed, an offer which I am sure has been accepted by many. These are his remarks; he says, "The one I have made works splendidly, and I advise all my amateur friends to make one without delay." They will soon find out "why." Mine is cast in gun metal. The reason I have called attention to Iota's words is this, perhaps some of our readers at the present time did not take in Part 36, and have not seen the article referred to, but I daresay would be able to get the back number, for I most emphatically say that I have never seen or come across anyone who has as yet not succeeded far beyond his expectations in making the planes I then described. Since they were published, I have since made another one of still rather improved form. The top part of the front of them is a great deal of trouble getting up, but to obviate that, and at the same time to carry out an idea of mine, I carried the side round the front about ½ inch deep, which of itself forms a thumb rest, and at the same time strengthens the plane, as before it was very weak, if you will notice, at the part where the hole in the sole is. The recess in the top thus formed could be filled up level with some fancy wood, or it could still be got up with a little more trouble at the amateur's own option. Another improvement I wish to speak about, is the shape and design of the handle; let the handle project out a deal longer than shown about 5 inches from where you rabbet it down, and don't make a ball end either as shown, but carry it out parallel in thickness with the blade. Round the top and end nicely to fit your hand, and I am sure you will like it much better than the one hitherto shown; but I think it is nearly time I begun to adhere to the subject of this paper which is trammels, radiators and chisel handles.

In Fig. 29 we have a pair of brass trammels which I intend to be made for a large pair, the size being increased double to that drawn. I will not mention any sizes as they can be easily got off the drawings, all of them being to scale. For Fig. 29 we shall first require a pattern made, which being made can be took to the nearest brass-founder, and the castings obtained for about 9d. to 1s. per lb.

Now to the pattern. Get a block about ¼ of an inch in thickness, thicker than the rectangular block in the centre and rather longer in length than shown. Then turn up the parts A and B; after, with scribing block, set out a centre line longitudinally. Perhaps the easiest and simplest way for the amateur to do this would be to turn a pin at either end of A and B, each the same size in diameter, then get two pieces of wood

about 2 inches broad, any length, and about ½ inch in thickness ; gauge a parallel line from the squared edge, and describe and pare out a semicircle the same size as the pin turned, fasten the two pieces down on a level board, and your centres being parallel with that board, the line drawn will be parallel which is what is required ; all this is done in less time than it takes me to tell you. Well, having got the line, set out at equal distances (allowing full size for fitting up) on either side the width of from C to D pare down to the lines drawn ; having done that bring the scribing block into use again, and get another centre line at right angles to the one hitherto got, set out as before to the thickness of Fig. 30, which should leave you a pattern like Figs. 29 and 30 minus the appendages. For the covering out affix pieces on either side, as shown by the dotted lines in Fig. 29, not forgetting the little corner piece K, which is in imitation of the top catch piece L, which is a separate part. If it is desired to use a blacklead with these trammels, cast block M on as shown at Fig. 30, afterwards drilling hole size of lead used, if not required cut out in block the lightening recess shown at E, Fig. 29, which improves the appearance and saves your money at the same time.

For the core-box use a piece of pine the same thickness as Fig. 30, minus thickness of metal by about 4½ inches long by 2½ inches in breadth, set out, and carve a hole the size from F to G and H to I in Fig. 29, right through and square down the full thickness, which must be sent with the pattern to the brass-founder. So far the trammel pattern is complete, but you require patterns for the thumbscrew, and the loose piece L, which however, the sketches will speak for themselves, make them full, however, in size for finishing. The spindle R being steel can be easily turned and tapped in the body B. In Figs. 31 and 32 we have views of handy bench trammels, which will perhaps please the amateur better than the others, as they can be turned bright all over as seen. The method of procedure is precisely the same as before only if you have the bracket for blacklead you would not be able to turn the body up the same, the coring out of the pattern, and the core-box to be done exactly the same way as the one previously described. They are, I make bold to say, as neat a design as you will find in a day's march ; let the thumbscrew at the top be milled on its edge, which greatly increases its turning power. At Fig. 31 we have a section through the line A B of Fig. 32, which shows the design more fully, so much for the brass ones. Now for another section of readers and amateurs. In Figs. 33 and 34 we have two views of a handy pair of wood bench trammels, the body part being of an irregular octagon section, perhaps one of the best woods for to make them out of is beech, the part C and D being turned, and the octagon worked afterwards. Fig. 34 is the loose one, the fast one will not need—(in this case one is better fastened to the trammel rod)—the wedge shown at F in Fig. 34. These are very cheap and easily made trammels, the part E being a bradawl knocked in the body D. Now for a little more variety still. In Figs. 42 and 43 we have a handier pair than the preceding ones, though perhaps a little more care is required in their workmanship ; they are turned as far as the line A B, the rectangular block having all the corners took off, gradually dying into the round part below the line A B. The thumbscrew, I must refer my reader to page 220, Figs. 16, 17, 18 and 19, where they will find a description given by me of a gauge worked the same way, and it will therefore save giving directions here ; they will apply just the same to the trammels described above, and shows the idea more fully. The spindle E is an ordinary bradawl again, D is a ferrule to hold it firm.



In Fig. 37 I just show the method of working the bevel hitherto described ; you will perceive how the blade can be shifted to the other centres. In Figs. 35 and 36 we have two views of a radiator ; I find in Vol. IV., page 354, one described there under the

title of centre square; you will perceive that these designs are much neater, and I might say more efficient. Use some fancy hard wood, the sketches explain themselves; in Figs. 44 and 45 I give an alternate view of one. It can be used for a small T square, besides radiating to the centre on any curved show pretty clearly what is required: A the blade, B the stock, D and E the pins. In Figs. 38—41 we have four views of handles for paring gauges and chisels. Figs. 38 and 39 being my favourites, they may be useful to the amateur if he turns his own, and I think he will, if he has any pride in his tools. Let him

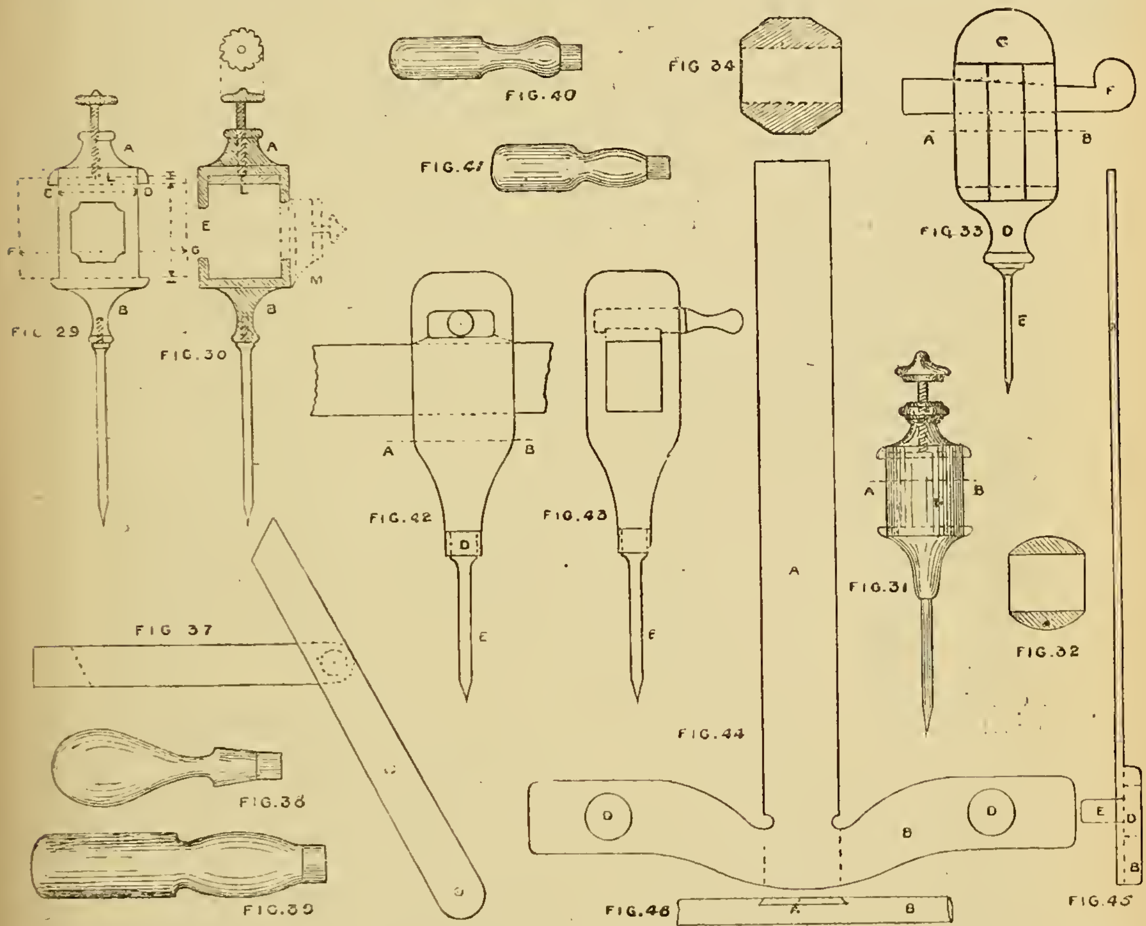


FIG. 29.—SIDE ELEVATION OF LARGE BRASS TRAMMEL. FIG. 30.—SECTION THROUGH CENTRE OF DITTO. FIG. 31.—SIDE ELEVATION OF HANDY BRASS TRAMMEL. FIG. 32.—SECTION THROUGH A B OF FIG. 31. FIG. 33.—WOOD BENCH TRAMMEL. FIG. 34.—SECTION THROUGH A B OF FIG. 36. FIG. 37.—MODE OF WORKING BEVEL. FIGS. 38, 39, 40, 41.—VARIOUS FORMS OF HANDLES SUITABLE FOR BENCH USE. FIG. 42.—ELEVATION OF WOODEN TRAMMEL. FIG. 43.—SIDE ELEVATION OF DITTO. FIG. 44.—PLAN OF ALTERNATE RADIATOR. FIG. 45.—SIDE ELEVATION OF DITTO. FIG. 46.—END VIEW OF DITTO. FIGS. 29, 30, 38, 39, 40, 41, ARE QUARTER SIZE; FIGS. 31, 32, 33, 34, 42, 43, 44, 45, 46, ARE HALF SIZE; AND FIG. 37 ABOUT ONE-EIGHTH SIZE.

piece. I don't remember having seen any other than the one I have made, but still by saying that I don't wish to raise a controversy in this journal, because I don't say there is no more like it; all as I say is, I have not seen or heard of any. You want a good sound piece for the blade, and let it in the stock with a dovetail joint, as shown at Fig. 46. I think I shall have no need to go into any explanation of the making, as the views remember a shop adage, it is this, "A good workman can be told by his tools." I myself by looking at a man's tools could tell in an instant what sort of a workman he was. I have never been mistaken yet, but so far so good, for I have not left you altogether. I hope now this series of articles is concluded, all being well, I shall be with you again before long with another series.

RETOUCHING PHOTOGRAPHIC NEGATIVES: ITS USES AND ABUSES.

By C. C. VEVERS.

GREAT has been the contention of late years amongst the photographic profession, amateur photographers, professional retouchers, and artists, as to whether retouching is a necessity to further the truthfulness and artistic beauty of a photographic negative. Is it essential to retouch every negative, before it is handed over to the printer? Is it destruction to the natural resemblance of the sitter to operate with the retouching pencil on the negative? Or, is it only necessary to retouch those negatives which do not, to a certain extent, show the sitter to advantage, those which magnify unnecessary blemishes, or those negatives which are in some way or another defective, owing either to the lack of skill shown by the operator in posing, focussing, or exposing, or faulty apparatus? Each of the above queries has been answered in the affirmative from time to time by different members of the fraternity, whose taste and opinion as to the artistic management of the photographic negative must consequently differ from that of some of their brethren. Some photographers would let their business go to "smash" before they would allow a retouching pencil to be used in their studio. "Why should we turn out a photograph resembling the features of a wax doll more than anything else, and then try to persuade our patrons that it is a correct likeness of themselves?" they say. Others go to the other extreme; they say, "Our customers like flattering, and if they pay us for it, why should we not suit them?" Then they completely cover the face with pencilling, and the result is, in most instances, very far from flattering.

It is interesting and amusing to note the arguments the advocates of retouching bring forth to war against their opponents, the non-retouchers. The latter have, no doubt, some very substantial and conclusive reasons to back up their aversion of this art. In the first instance they claim that if a negative has been properly focussed, exposed, and carefully developed, and the subject correctly posed and lighted, the introduction of this inimical process (to them it is no art) is to simply *murder* the negative. The sitter should be properly focussed. If on the development of the plate the subject be found to have moved, or (through the operator's inability or carelessness) it is out of focus, another plate should be exposed and a good negative obtained without having recourse to retouching. This may be correct, but, I think, when they claim (and the majority of them do) that if the subject is properly lighted there will be no need of "scratching the film with a pencil" that they are exaggerating not a little.

Why, they say, should the wrinkles and furrows be taken out of the picture? It cannot then be a likeness of the person it is intended for. A lady with a slightly "tip-tilted" nose is taken: the retoucher straightway takes the negative, and with his pencil turns it into a shapely Greek nasal organ because he thinks "it will please the lady." This may be making a *picture*, but it is certainly not taking a *likeness*.

The following I extract from a letter written on this subject, which appeared in one of the photographic journals some months ago. The writer, after entreating all amateurs to avoid retouching, continues: "What truth would there be in a photograph of a view wherein oaks had been turned into poplars—meadows into cornfields, or leafless trees into those in full leaf—all by the retouching pencil? What would be the value of a photo of an old castle or abbey which had been retouched until it looked like the latest production of the art of the jerry builder? Suppose a building with square windows turned out in a photo with round-topped ones, or Doric columns changed into Ionic or Corinthian, because to some depraved tastes the latter appear the more graceful? If retouching would be absurd in such cases, it is a thousand times more ridiculous in the case of photos of the human face and form, and amateurs should resolutely set their faces against it. At best it is a makeshift, worthy to rank with the work of the unscrupulous sculptor who fills up the cracks in his marble with putty and shellac—or the carpenter who hides his bad joints with filling in of glue and sawdust, and trusts to the final coat of polish or varnish to still further blind the eye to his clumsy handwork. All such practices are rather artful than artistic, and unworthy a moment's thought by the amateur who has any art-feeling at all."

In my opinion most negatives require more or less retouching, *but not too much.* In most cases all the defects should be taken out of the face, *young and middle-aged people especially.* By defects I mean freckles, blotches, furrows, etc., such as are blemishes of the skin; but never, in any case, should the modelling—or outline—of the face be interfered with, as this is the true cause of losing the likeness. It is a well-known fact that yellow and brown photograph much darker or blacker than they appear to the naked eye; freckles and furrows are mostly of a yellow colour, and are, therefore, greatly magnified upon the negative. If the prints were turned out from this untouched negative, in nine cases out of ten, they would be as surely returned with a note saying the customer didn't like the photos as they were not at all like him or her; they had been shown to some friends of his

or hers, and these friends said they were sure he "hadn't got small-pox, and was it in a duel or in the wars where he got that dreadful scar?" (meaning the shadowy line from the side of the nose to the mouth). Then the photographer must get his negative retouched and print another batch of photos from it in that state, or lose his customer.

But too much pencilling can spoil the photos equally as well as too little. Some negatives, in fact, do not require retouching at all; this applies chiefly to babies and young children, whose round, plump cheeks very rarely have any defects to remove. Dimples in children are beauty spots (so the mothers think), and should be preserved with the utmost care, as it would be dangerous for the operator if he were to remove one; he might expect the mother round when she got the photos—then woe betide him! Much has been said by those in favour of excessive retouching; amongst other absurdities they say that out of a poor negative, with careful retouching, they can make a perfect picture. This I do *not* agree with. If retouching must be done, do it on a good negative, or not at all.

Apparatus required.—I will now describe the necessary apparatus, which is not much and very cheap. The principle item required is the retouching desk. This should be made to take the largest negative the amateur works. A few good drawing pencils of different grades of hardness, say BB, HF and HB (Faber's are by far the best for retouching purposes), a sharp penknife, some fine emery paper, and the retouching medium.

The Retouching Desk.—Any reader of AMATEUR WORK should be able to make for himself, or at worst any joiner would make one from the following instructions for two or three shillings. I should not advise him to get one from the photographic dealers, as they would charge him at least ten or fifteen shillings, and I do not suppose any of my readers will want such an elaborate affair as is usually sold there. My desk is made to take plates up to 9 inches by 7 inches, and as I think that should be large enough for any amateur, I will describe how to make such an one; of course, it is very simple, but it should be sufficient for his requirements.

First, cut two boards out of $\frac{1}{4}$ inch wood $11\frac{1}{2}$ inches by $9\frac{1}{4}$ inches. These are to form the top and bottom of the desk. Now for the frame to hold the negative: it is made something after the style of an ordinary school slate. The sides are formed out of two pieces of wood 1 inch thick and 1 inch wide; they must measure $11\frac{1}{2}$ inches at the outside and $9\frac{1}{2}$ inches at the inside; a groove must be cut at the inside of each piece $\frac{3}{4}$ inch deep and $\frac{1}{8}$ inch wide. That done, three square holes must be sunk in each piece $\frac{1}{2}$ inch square and $\frac{1}{4}$ inch deep. The first of these holes must be 2 inches from the bottom, the next 3, and the last 4 inches. (See Fig. 1.)

The top and bottom pieces must now be made; these are the same width and thickness as the sides, and measure $9\frac{1}{4}$ inches at the outside and $7\frac{1}{2}$ inches at the inside. The grooves must be cut corresponding with the sides, $\frac{3}{4}$ inch deep and $\frac{1}{8}$ inch wide. These grooves should be cut in the sides, top, and bottom $\frac{5}{8}$ inch from the top edge—that is, the side where the square pieces are cut out.

Now obtain a strong sheet of clear glass 10 inches by 8 inches—some retouchers prefer very fine ground glass, but I find ordinary glass answer the purpose quite satisfactorily—and after cleaning it, fix the frame round it, and fasten the corners well together by either screws or nails. You have now a frame containing a sheet of glass, the inside of the frame measuring $9\frac{1}{2}$ inches by $7\frac{1}{2}$ inches (Fig. 2).

The top and bottom must now be hinged on to the frame. Take one of the boards before mentioned, and hinge it on to the frame at the side where the holes are, and farthest away from them. Two hinges, measuring about $1\frac{1}{2}$ inch, should be used; the fold of the hinge screwed to the frame should be sunk into the wood deep enough to allow the other fold, when turned in (that is, when the desk is closed) to come level with the frame. (Fig. 3 will illustrate my meaning.) This will allow the lid, when closed, to lie flat on the frame. This forms the top of the desk.

The bottom should be hinged on in the same manner, the only difference being that this board must be fastened at the opposite end of the frame and at the under side.

Fig. 4 shows a piece of slightly curved iron, about $\frac{1}{16}$ inch thick. Make two of these and screw them on to the outsides of the frame, about 5 inches from the top. These are the supports for the top and frame of the desk.

A bar of wood must now be made to fit from one recess to the other in the sides; it, therefore, must be $8\frac{1}{2}$ inches long and about $\frac{3}{4}$ inch wide by $\frac{5}{8}$ inch thick. The ends must be cut so as to fit into the recesses at the side, not to be fastened in, but so that it can be moved from one to the other as desired. A piece must be grooved out at one side at the edge about $\frac{3}{16}$ inch deep and $\frac{1}{4}$ inch wide; the bar is made to support the negative to be retouched, and when the ends are put in the holes at the sides it should fit close up to the glass in the frame, the piece cut out forming a kind of groove for the edge of the negative to stand in. (See Figs. 5 and 6.)

On the top lid of the frame tack a piece of black twill, at the sides and front, so as to form a cover to exclude all light from entering over the operator's shoulders. I must not omit to say that if ground

glass is used in the frame, a mirror will be required to reflect the light through it; if ordinary glass is used, a sheet of white note paper will do. The inside of the desk should be painted a dull black, the outside varnished, and the desk is complete (Fig. 7). The desk, after use, can be folded to $11\frac{1}{2}$ inches by $9\frac{1}{4}$ inches by $1\frac{1}{2}$ inch (Fig. 8); and all of the accessories used can be kept inside.

A good substitute for ground glass can be made by flooding the following varnish over the back of the piece of clear glass in the frame: Ether, 2 ounces; emery paper, so as not just to sharpen the end of it, but to gradually taper the whole lead away to, a long point. The difficulty will be discovered on the amateur attempting to do this, as the lead will break off upon the least pressure being applied. Having sharpened the pencil away to what you will think a beautiful point, it must be further rubbed on a piece of paper—brown paper answers best—this makes the point still finer and takes away most of the gritty particles that may adhere to the lead. The three pencils sharpened, they must be put on one side, the

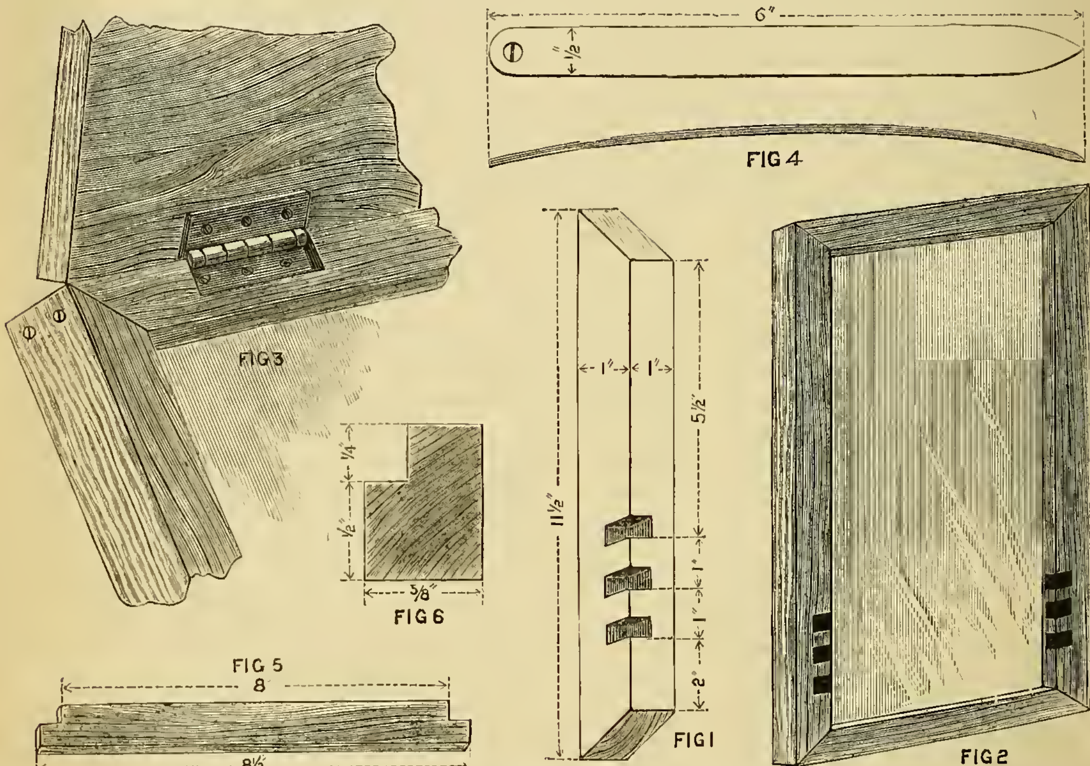


FIG. 1.—ONE SIDE OF FRAME OF RETOUCHING DESK. FIG. 2.—FRAME COMPLETE. FIG. 3.—MODE OF HINGING BACK TO FRAME. FIG. 4.—IRON SUPPORT. FIG. 5.—BAR OF WOOD. FIG. 6.—SECTION OF BAR.

benzole, 1 ounce; sandarac, 75 grains; gum mastic, 20 grains.

How to Retouch a Negative.—We will suppose you are my pupil, and I am about to give you a lesson in retouching.

Well, then, the first thing to do is to sharpen your pencils to a good point. This, though apparently simple, is not so easy as it looks *to do it properly.* Retouching pencils must have the sharpest possible point, as shown in Fig. 9—a point that will not be rubbed off after one or two strokes on the gelatine film. With your knife cut away the wood, leaving the lead bare for at least ½ an inch; rub the pencil on the desk fitted up, and the surface of the film prepared, so as to give a "bite" to the lead.

There are several preparations sold for this purpose, both in liquid and powder, but you can make almost any of these yourself. Here is a recipe for one to be used as ordinary negative varnish: Methylated spirit (alcohol), 12 ounces; sandarac, 2 ounces; castor oil, 170 grains. The sandarac must be dissolved in the spirit, and the oil then added.

Lump resin powdered very fine is also a good medium, but great care must be taken in applying it to the film. It is rubbed on with the finger (which should be perfectly dry), and rubbed round and round

over the part to be retouched. It will take you some time to get into the "knack" of this, and I should advise you to use, at first, one of the liquid mediums. The resin is usually rubbed on before the negative has been varnished, and, unless very great care is taken it will scratch the film, and, of course, spoil the negative.

We will suppose the negative we are just going to retouch to be a cabinet size head and bust of a lady, with a bonnet on her head. Having applied the medium we put the negative in the frame of the desk, fixing the loose bar of wood so that the negative rests at a convenient height to work at. The frame should be at an angle of about 45°; the sheet of paper or the mirror at the back must be raised or lowered so as to reflect the light through the negative. The desk is best placed near a small window, in a room where very little light enters except through that window. Pull the black twill fastened to the desk over your head and shoulders so as to exclude all light except that which comes through the negative; this will enable you to see the small defects, etc., in the negative much better.

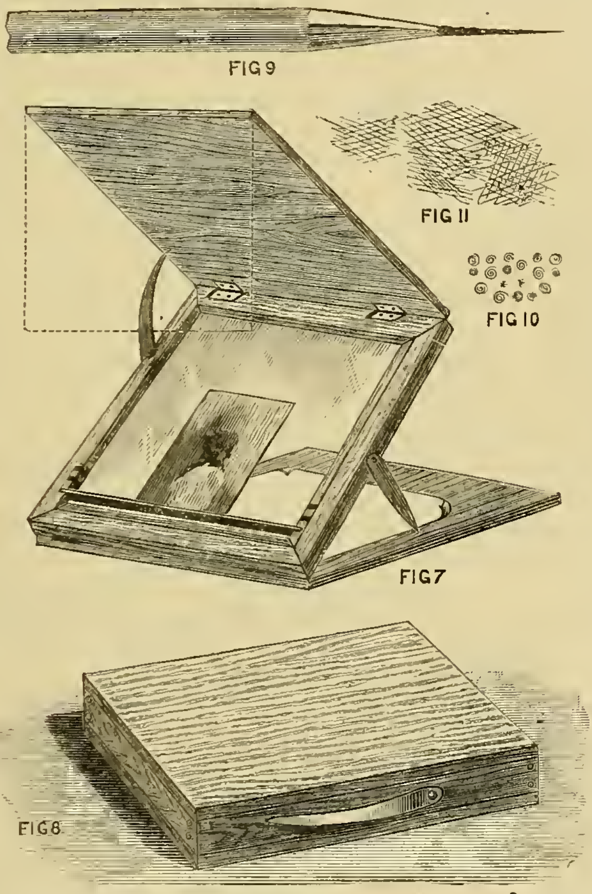


FIG. 7.—RETOUCHING DESK, COMPLETE AND OPEN. FIG. 8.—DESK CLOSED. FIG. 9.—PROPER METHOD OF SHARPENING PENCIL FOR RETOUCHING. FIG. 10.—SPIRALS, ETC., FOR RETOUCHING TRANSPARENT HOLES, SPOTS, ETC. FIG. 11.—CROSS-HATCHING IN SHORT LINES FOR SOFTENING SHADOWS AND BLENDING THEM WITH LIGHTS.

Everything ready, with your medium pencil (HB) carefully fill up all the small transparent spots, such as freckles, pimples, small-pox pittings, etc. Commence at the left side of the forehead and then over to the right; little or no work will be required here the first operation. Work over the left side of the face, the sides of the nose, the right cheek, and lastly the chin. The mode of laying on the lead is as follows: Gently put the point of the pencil in the centre of the transparent hole or spot, and, working in the form of a spiral, gradually widen the lines, until the spot is correctly filled in and the same depth as its surroundings. The diagram shown in Fig. 10 will explain what I mean.

With the same pencil, the eyes must be touched up. This is a very difficult proceeding, and I should advise the beginner, unless the eyes of the subject are *very* bad, to leave them alone until he has acquired more practice and skill in retouching. The whites generally require strengthening, and this must be done with a steady hand, or the lead may be run into the pupil and cause the subject to appear to be squinting. The lights of the pupil often want touching, and this, also, requires great care.

The hardest pencil (HF) is now brought into requisition; with this again go over the face, this time filling in all wrinkles, scars, and furrows. Some of these do not want retouching out altogether. Very little should be done with the wrinkles of old age, but in this case it is a middle-aged lady we are retouching, and, no doubt, she would prefer every wrinkle in her face taken away, but this we cannot do consistent with truthfulness. There are usually one or two small wrinkles on the forehead—these should be almost wholly obliterated; the light down the bridge of the nose strengthened; the two shadowy wrinkles distinguishable in almost every face — from the sides of the nose to the corners of the mouth—although not touched out completely, should be softened away to some extent. Any other wrinkles or furrows about the face and neck should be looked to; and I think you will find the face much softer in appearance.

The next movement is to look to the shadows; some of these often require blending into the high lights—the hollow of the cheek, for instance. Should the shadows in any place be excessively deep they

may be covered with a wash of thin Prussian blue (water colours). The shadows and dark markings under the eyes must be seen to ; one of the principal lines passes from the inside corner of the eye in the direction of the ear—this should be filled in, as also should any shadows in the forehead.

The lady in the negative we are retouching wears a bonnet, and this causes a too dense shadow over the forehead, owing to too much "top-light" being used in lighting the subject. This must be remedied with the soft pencil.

Now to finish, we must again bring the HF pencil to a very fine point, and go over the whole face after the fashion of stippling. Commence at the forehead and work down to the chin lightly, making very fine lines, as show in Fig. 11.

These lines should go with the "grain" of the skin, and should be put in rather close in the shadows and wider apart in the high lights. These lines make the face look soft and round, and should be hatched in very carefully, as they are, perhaps, the most particular part of the work. The pencil should have an exceedingly fine point, and the lines must be put in very clear, fine and light.

Having finished the face to your satisfaction, the hands, if there are any shown, should be just touched a little, *but not too much.* Any lace could be improved by a little judicious pencilling, and innumerable little defects can either be totally touched out or improved.

To anyone reading these instructions, retouching will appear to be a very difficult art, but I think they will find it very simple after a little practice, *but don't experiment with any valuable negatives.* Those who are fair hands at drawing and sketching will find it comparatively easy. I have often wondered why so few ladies learn retouching ; it is a very clean, pleasant, and (to those who wish to make a little money) profitable occupation. One lady of my acquaintance makes from 20s. to 35s. per week, working only a few hours per day, by retouching for a few photographers in her neighbourhood.

The principal virtue required to make a good retoucher is PATIENCE.

So much then with regard to the art of retouching photographic negatives and its practice. I have shown how the operation should be carried out, and I am inclined to think that no one who has the will to take it up, and ability in the use of the pencil, combined with a set and steady purpose to follow the instructions that have been given, will find any real difficulty in its performance. I may, I trust, find forgiveness, if I venture to reiterate the necessity of patience and perseverance, without which none can hope to attain excellence in any pursuit or occupation, be it what it may.

NOTES ON NOVELTIES.

By THE EDITOR.

11. CREWE'S IMPROVED SYSTEM OF GLAZING WITHOUT PUTTY. 12. MALEHAM'S AMATEUR FRENCH POLISHER'S CABINET.

11. CREWE'S IMPROVED SYSTEM OF GLAZING WITHOUT PUTTY.—Among the subjects that possess a peculiar attraction for gardeners, are those of heating greenhouses in the most efficient manner, and of glazing greenhouses, etc., without being subjected to the nuisance of bedding and securing glass with putty. A description of the greenhouse gas boiler, contrived for heating small greenhouses by Mr. H. T. Crewe, 17, *Sunning Hill Road, Lewisham, S.E.*, will be found in page 75 of this Volume. With regard to glazing without putty in a thoroughly efficient and reliable manner, I venture to think that Mr. Crewe has also hit the mark in the invention that I am about to describe.

This new and useful method will be rendered perfectly clear to any one who will consult the diagrams, Figs. 1, 2, 3, 4, in the accompanying illustrations of the system. In Fig. 1, which affords a perspective view of part of a roof glazed on Mr. Crewe's system, E is the wood plate or sill, which is laid on the top of the dwarf brick wall in a house of low pitch at the sides, or on the wall-plate that surmounts the front lights in an ordinary lean-to house, or the side lights in a span-roof house. This sill is bevelled on the inside as well as on the outside, to carry off any drip from the glass that may reach it, and prevent any lodgment of water. Into the wood sill are let the intermediate rafters, or bars, A, which have a double groove along the upper surface from end to end, to carry off any water that may find its way in between the abutting ends of adjacent panes of glass. A full-sized section of this bar, showing the form of the double groove, F F, is given in Fig. 2. Returning to Fig. 1, we see that the panes are laid on the rafters, and are cut of such a size that their width is exactly equal to the distance determined on from bar to bar, taken from central ridge to central ridge, between the grooves, on the upper surface of the bar.

In glazing the roof, the panes, shown at B, in Fig. 1, are placed over one another with a slight lap in the usual way, the ends meeting over the central ridge between the grooves in the intermediate bars. The upper corners of each pane are cut away, to allow of the passage into the bar of the screw which enters it, and is screwed down until it bears closely but not too tightly, as shown at D, on the metal clip C, one of which is placed over the spot where the four adjacent corners of contiguous panes meet, and does its part in holding down all four panes. The slot in the metal clip has a circular termination in the upper part, so that when it is necessary to remove a clip, there is no occasion to withdraw the screw, for when two or three turns of the screw has been made and the clip is loosened, it is only necessary to draw it downwards until the head of the screw will pass through the round hole at the end of the slot. The screws are made of brass. For attaching and securing glass at the

sides of a glazed roof an angular clip is used, shaped as at G, in Fig. 4. The plain clip is shown on a larger scale in Fig. 3. The great advantages claimed by Mr. Crewe for his invention are its economy in cost and labour, its simplicity and its superiority in these points over other systems that have been already placed before the public. The glazing, further, is absolutely free from internal drip, and is rain-proof. No perishable india rubber or any other kind of packing is used. There are no bolts or nuts to remove. The screws, as it has been said, only require to be loosened two or three turns, when the metal clips can be slid off or

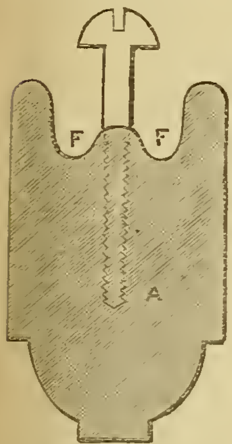


FIG. 2.—SECTION OF INTERMEDIATE BAR OR RAFTER—FULL SIZE.

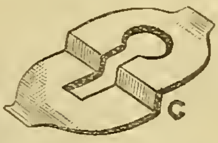


FIG. 3.—FLAT METAL CLIP FOR GLASS.

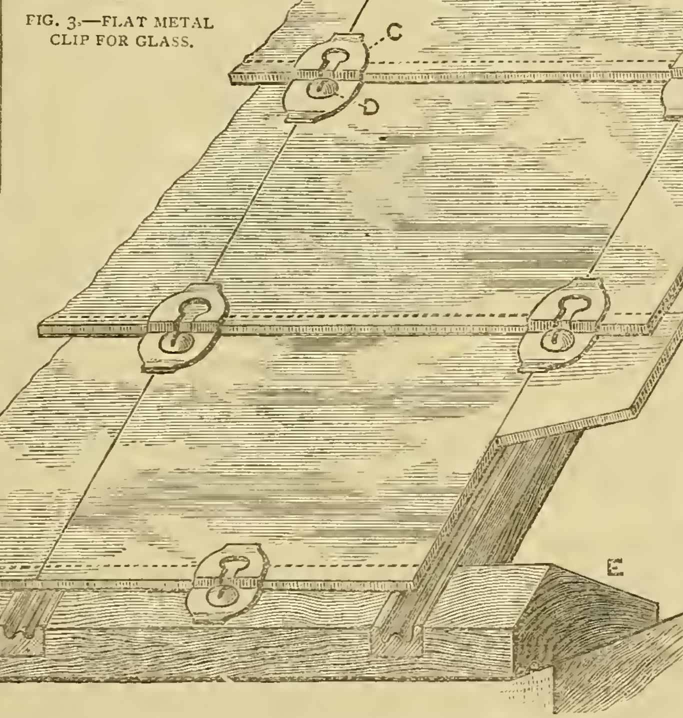


FIG. 1.—PERSPECTIVE VIEW OF PORTION OF ROOF GLAZED ON CREWE'S SYSTEM.

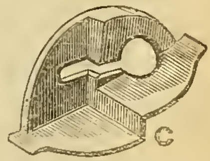


FIG. 4.—ANGULAR METAL CLIP FOR GLASS.

on, as required; the screws being simply for tightening the clips, and not being entirely withdrawn when the clips are removed, cannot be lost or mislaid. All intermediate rafters and wood work being entirely covered with glass, are protected from the weather, thus greatly adding to durability and lessening repairs, etc. The glass can be removed quickly and without injury when it is necessary to do so for repainting, cleaning, or removing the structure, and can be as quickly and easily replaced after so doing. Broken glass can be replaced with new by any unskilled person, and with greater facility than in any other system. The method of securing by clips, etc., is equally applicable to straight or curvilinear framing, for which wood or metal bars may be used as preferred. Full provision is made for all expansion and contraction, thus obviating fracture from these causes.

12. *Maleham's Amateur French Polisher's Cabinet and Tool Chest Companion.*—I have received from Mr. H. W. Maleham, 59, *Arundel Street, Sheffield*, a very handy article which he calls the "Amateur French Polisher's Cabinet and Companion to the Tool Chest." It is in the form of a strong and well-made tin box, fitted with a hinged cover or lid. The box itself, when closed, is 8 inches long, $3\frac{1}{5}$ inches wide, and $1\frac{1}{8}$ inch deep, and is nicely japanned. Within are all the materials and appliances necessary for French polishing—namely, a bottle of French polish, another of linseed oil, and a third of rectified naphtha, with a roll of soft calico and cotton wadding, and a piece of very fine sandpaper. The materials are accompanied with full directions for use, in which the process is briefly but clearly described from the commencement to the finish. The contents of the Cabinet, indeed, appear to be of excellent quality, and the case strong and durable, strengthened as it is by being divided into three compartments, two of which are occupied by the linseed oil and rectified spirit, the middle and longer compartment being assigned to the French polish, the calico and cotton wool, and the sandpaper. The Cabinet will be sent post free to any address on receipt of 1s. 6d. It will be found most useful by beginners at this kind of work, and fret-workers and turners will like it because it affords them the means of keeping all they require for French polishing always at hand, in a neat, compact, and convenient form.

AMATEURS IN COUNCIL.

**** For Instructions to Correspondents, see page 44 of this Volume.*

PRACTICAL SCENE-PAINTING FOR AMATEURS.

*** Owing to the failure of the artist to reproduce Mr. Benwell's illustrations of Scene Painting in a suitable manner, the Editor is reluctantly compelled to postpone the appearance of the next Chapter until Part 52, March, 1886.

How to Make and Work Still.

E. A. J. (*Dublin*).—An excellent portable water distillery for photographers, is described by Mr. C. C. Vevers, in Vol. IV., page 457, which will doubtless serve your purpose. A paper on Making Perfumes by Distillation, and other modes, will be found in Vol. IV., page 270.

Graph Composition.

M. H. W. (*Manchester*).—The composition you require is what is generally known as "Graph Composition." See Vol. IV., pages 96, 207, 304, 311, 358, for information on this subject.

Cycling as an Exercise.

M. H. W. (*Manchester*).—You ask, "is cycling the best exercise?" For strengthening the muscles of the loins, thighs, and legs, there is possibly no better; but as a general exercise, I, myself, am inclined to think that walking is the best, and most readily and easily obtained. You further ask, "for what complaints is it the best preventive or cure?" It prevents and cures *ennui*, brings torpid livers into action, and promotes good fellowship, like every other athletic exercise.

Barbotine Work.

Mad Jack.—You will find a paper, entitled, "Barbotine Work: How to Imitate It," in Vol. III., page 511, of this Magazine, which gives you the information for which you ask.

Fire Escape.

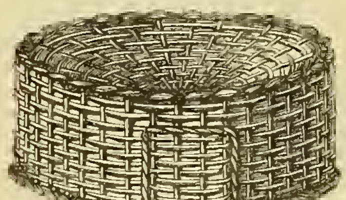
G. B. (*Cheltenham*).—In all probability the Fire Escape to which reference is made in the newspaper cutting you send is Gillingham's "Spider" Fire Escape, a notice of which you will find in Amateur Work, Vol. III., page 434. All particulars can be obtained from Mr. James Gillingham, Surgeon-Machinist, *Chard, Somerset*, if you send an envelope duly stamped and addressed, for transmission of prospectus to you by post.

Embossed or Traced Work on Panels.

Mad Jack sends the following extract from Smith's "School of Arts," exhibiting a method of embossing or tracing all kinds of ornaments on a smooth gilt panel, the gold being overlaid with black or any other colour:—"First gild your panel, or other woodwork, and when thoroughly dry, paint it all over smooth and even with lamp-black, ground with linseed and nut oil; add to it an equal quantity of umber, in order to dry it the better; after you have set it for two or three days, or more, according to the time of the year, to dry, then, before it is quite hard, draw or pounce what you design to emboss, and with a blunt-pointed bodkin, horn, or wood, trace into the black lay, down to the gold, opening the traces, and making the gold appear in the best manner you can. In birds, plants, cattle, and such like, you must observe to take the heightenings clear out, and leave the shade, by hatching into the black, agreeable to your design. The fine and soft shades of the hair, etc., you may finish with a fine pencil, with the black colour upon the gold; and when you have done, let it dry thoroughly for three or four days more, then lay over it a clean varnish, which you may, after it is dried, repeat a second time, and your work will look beautiful."

Trap for Sparrows.

D. G. T. (*Somerset*) writes:—"In p. 47 of this volume of Amateur Work I notice the description of a trap for catching sparrows, which is a very good one, but which has this disadvantage, viz., that it requires setting after each sparrow is caught. The following is one which requires no attention at all: It consists of a willow cage, the top of which slopes downward to the opening, as shown in the annexed illustration, section F. The hole is about 2¼ inches from the bottom, and of sufficient diameter to



BASKET TRAP FOR SPARROWS.

admit the sparrow. The ends of the twigs which form the cover are bent downwards, so that it renders it easy for the bird to hop in after the crumbs placed inside, but when it attempts to get out it finds that the hole is too high for it to hop out, and when spreading its wings to fly out, it finds the hole is too small. Of course, there is a suitable door in the side to admit the hand to take them out. If a bird is placed inside, it will attract the notice of others. The cage is placed in any position where the sparrows are in a habit of congregating."

Penknife Blades.

W. H. T. (*Notts.*)—Penknives are generally sent away, even by ironmongers in large towns, to be repaired, and I do not think, as a rule, that ironmongers and dealers in hardware keep them in stock. The blades, in every case, have to be suited to the handles. Try Messrs. Richard Melhuish and Sons, 55 and 57, *Fetter Lane, Holborn Circus, London, E.C.*

Rubber Stamp Making.

C. E. C.—For a reply in full to your question on this subject, please see Vol. IV., p. 94, foot of col. 3. Sailmaking still remains a subject of the future, but Mr. A. C. Hide says something about this in his papers on "Model Yachts."

Black Stain and Varnish Combined.

Messrs. Stevens and Co. (*Torbay Paint Company*, 26, 27, and 28, *Billiter Street, London, E.C.*) write:—"We notice that in your November issue you refer one of your readers (W. H. P. [*Devonport*]) to us for stains for wood, etc., and we beg to thank you for this courtesy. Will you kindly note that we supply an Ebony, or Black Stain and Varnish combined, which will not scratch like an ordinary varnished surface. We send you herewith a specimen on wood, stained one coat only, and afterwards polished." [The specimen sent is excellent in both colour and polish, and is well worth the attention of all who require a combined stain and varnish of this kind. It is applied to a piece of soft deal, and gives a totally different character to its surface.—Ed.]

Violin Making a la Guarnerius.

Savant.—The "principal points in the construction of a Guarnerius violin, and the method of building it on an inside model," are given in detail in Vol. IV., pp. 154, 211, in two papers, the first of which is accompanied by some elaborate full-sized diagrams in a Supplement or Folding Sheet. I am afraid you are not a regular reader of Amateur Work, or this would not have escaped your notice, as it appears to have done. You add: "I remember about the time that Mr. Allen described the manufacture of Violin Varnish, he gave the address of a firm in London who could supply it ready for use. Will Mr. Allen repeat the information?" I cannot ask Mr. Allen to do this as he would, with good reason, refer you to his articles on "Violin Making," but I may refer you to Mr. W. E. Hill, 72, *Wardour Street, Leicester Square*, who (see Vol. I., page 211) has undertaken to supply the amateur violin-maker with the necessary wood and tools, and will doubtless also put him straight in the matter of varnish.

Removal of Paint from Wood.

F. T. (*Harrow*).—If you do not care to remove the paint from your woodwork by burning, you must use Reudle's "Electric Paint Remover" (see Vol. IV., pages 198, 355), or try a very strong solution of caustic soda.

Type for Sale.

I. R. O. writes:—"Having recently purchased at first hand several exceedingly useful founts of fancy type, at prices far below those usually charged to amateurs, I am willing to divide them with my brother amateurs at prices very advantageous to them. The *divided founts* will be quite as large as those generally put up for amateurs. All are quite new, and specimens will be forwarded to any address on receipt of application enclosing an envelope addressed to applicant." [I will forward any letters that may be sent to I. R. O., but it is a *sine qua non* that all letters to be forwarded must be stamped for transmission per post, and marked, "Type, I. R. O." in the lower left-hand corner of the envelope, so that nothing remains for me to do but write the address on the letter and have it posted.—Ed.]

Harmonium Building.

Amateur Harmonium writes from *Melbourne, Australia*, to say that he has built a harmonium from the instructions given by Mr. Thomas Main in Amateur Work, and that the instrument plays very well. He bought the keys secondhand. He hopes that the knowledge of his success will be encouraging to others.

Electric Indicator.

OLD SUBSCRIBER.—An indicator for a six push arrangement must have six numbers, each number to correspond with each push. There are six electro magnets in such an indicator, and six wires leading to as many studs or screws on the instrument. The remaining wires of the magnets are all connected to one stud, to which the wire from the bell is attached. Run a wire from each push, and connect to its corresponding stud on the indicator. Connect the remaining wires of the pushes to the main line wire running through battery to bell, and on to the bell stud on the indicator. For further illustrated particulars, see page 265, Vol. IV.—G. E.

Compound Microscope.

MICRO.—I am pleased to hear of your progress in constructing a microscope. Respecting the test for showing when the lenses of an eye-piece are placed at the proper distance apart, I can only repeat that the eye lens having been placed in position, the diaphragm must also be placed as near as possible in its focus, the field lens is then to be pushed in towards the diaphragm until the edge of the latter appears quite sharp, and intensely black. When properly adjusted, the image of an object placed on the stage will appear to be exactly level with the edge of the stop. Perfectly transparent lenses, and consequent freedom from spots, scratches, or markings of any kind, are essential to form a good eye-piece. Any defects in the substance of the glass, imperfect grinding or polishing may be easily detected by using the flat mirror and ¼ inch objective. To your next question, I reply that Mr. Buckingham, *Blenheim Grove, Peckham*, advertises for sale optical glass of finest quality, crown and flint, all sizes up to 14 inches diameter. Respecting the curves for 1 inch objective, I must inform you that I have never attempted lens grinding myself, but a recent writer in the "English Mechanic" (who supplemented his information by stating that the same had been tried, and proved suitable for an inch objective) gave the following curves: "Two plano-concave flints of ⅝ and ⅞ inch radius respectively, and double convex crown of equal curves to match the flints. The two pairs to be cemented together with Canada balsam, and mounted at the proper distance apart to correct the spherical aberration. In 'Practical Microscopy,' by Geo. Davis, is a figure of an inch objective, a triplet, consisting of a double concave flint between two double convex crown lenses, a diaphragm being placed behind the back lens to cut off the marginal rays, but no dimensions are given, and unless the figure is an accurate copy, I am afraid it would not be safe to follow."—R. T.

Model Engines.

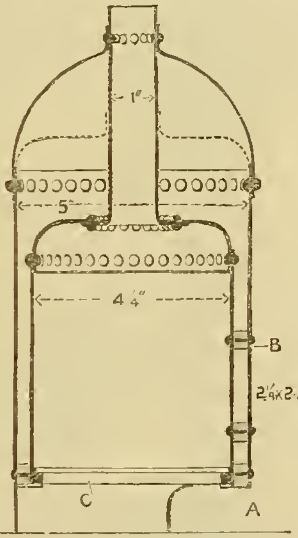
ENGINEER.—You may derive all the information you require from the series of articles on "Model Engine Making," from the pen of Mr. John Pocock, which will be commenced forthwith.

Ground Glass.

J. L. (*Weymouth*.)—Your best plan is to grind the surfaces of your glass slabs with emery. Prepare a thick paste of coarse emery powder and water, and spread some of it on a slab. Place another slab on top, and grind the two together. The surfaces will be abraded. If the grinding is too coarse, repeat the process with a paste of finer powder, and so on until the desired surface is produced.—A. F. S.

Vertical Boiler.

ENGINEER.—I must first apologize for my neglect in not replying to your query before this. I send sketch of boiler, which will meet your requirements. Figured dimensions are added to the sketch, which is on a scale of ½ inch. The boiler is to be made of sheet copper; "firebox" not less than $\frac{1}{20}$ inch in thickness. The shell may be $\frac{1}{32}$ inch thick. The seams are to be tinned before riveting, and "washed" with solder afterwards. The firebox should preferably be brazed, if you can rely upon the work being well done. A copper ring forms the bottom joint, and another of similar



SECTION OF VERTICAL BOILER.

thickness forms the opening for fire door. The fire bars are carried by a ring supported on lugs fixed around the bottom of shell. The bars may be of ⅛ inch wire, flattened at the ends to keep them apart. The crown of the shell may be as shown in ticked lines. Safety valve should be ⅜ inch in diameter, and loaded to 20 lbs. per square inch, at which pressure the boiler may be worked safely if well and properly made.—OLLA PODRIDA.

Fretsawing Attachment for Lathe.

E. S. D. writes:—"Immediately on receiving the September Number of AMATEUR WORK I set to work to make the Fretsaw Attachment for Lathe, described by OLLA PODRIDA. I found it easy to make, and most satisfactory when finished; the machine cuts even ¾ inch stuff without difficulty, and I can scarcely speak too highly of it. I hope OLLA PODRIDA will forgive my offering one or two suggestions. The bed in my machine, I have made of 1¼ inch stuff, and the supports for the table of 1 inch, and the complete rigidity of the table is a great comfort in working. Then as to the 'Spanish windlass' arrangement for tightening the saw. In OLLA PODRIDA's design the bar by which the cord is twisted is made to drop into a slot in the upper arm, the result of this is that when the saw has been strained tight by twisting the cord, the art of dropping the bar into the slot removes most of the tension. I find that the friction of the bar pressing against the upper surface of the arm is quite sufficient to prevent the cord untwisting. OLLA PODRIDA's measurements for the leather of the bellows I did not find quite correct. If the frames of the bellows are 2 inches by 1⅝ inch, and the leather is to overlap a ½ inch, and be stretched a ¼ inch, it must be cut 6¾ inches long, and not 7½ inches. I can testify to the efficiency of the blowers, and to the great comfort they are in working."

Le Page's Carriage Glue.

MESSRS. RICHARDS, TERRY AND CO., 46, *Holborn Viaduct, London, E.C.*, send me the following letter to which I am glad to give publicity: "We notice in your issue of this month a letter from A. H. A. (*Durham*) in reply to which we beg to say we do not remember having received a letter, enclosing 2s. 9d. in stamps, from anyone in Durham with the initials above mentioned. We are the sole agents for the United Kingdom, Continent of Europe, and the Colonies, for the sale of *Le Page's Fish Glue*, and all the Russia Cement Company's products, and were so appointed on the death of the late Mr. T. Eckhardt. Messrs. Phillips and Co., whom you mention, simply buy from us as customers, and do not carry on the business of the late Mr. T. Eckhardt. We send a sample bottle for 6d. or 1s., and cans in half pints, 1s. 6d.; pints, 2s. 9d.; quarts, 4s. 6d. each; and we guarantee the adhesive qualities to be in every respect the same as described on labels, and advertisements, or the money will be returned. At the New Orleans Exhibition joints made with this glue with two pieces of Georgia pine *one inch square*, glued endwise of the grain, stood the enormous strain of 1612 lbs. (to the square inch) before being parted. By placing these facts before your readers you will much oblige."

Removal of Varnish from Wood.

CLIFTONIAN.—You may remove the varnish from your overmantel by applying Rendle's "Electric Paint Remover," which is as efficacious for cleaning off varnish as it is for paint. It may be obtained from Messrs. W. E. Rendle and Co., 3, *Westminster Chambers, Victoria Street, S.W.*

Paper Varnish.

F. Y. G. writes:—"The following formulæ afford very good varnishes for drawings that have been previously sized with gelatine: Canada balsam, 1 oz.; oil of turpentine, 2 ozs.; or Canada balsam, 4 ozs.; camphine, 8 ozs." [With reference to the papers that you propose to write, you can send them to me on approval if you like; but before doing so it would be as well to write to me again on the subject, giving your name and address, that I may be enabled to communicate with you on the subject in the ordinary way.—ED.]

Battery for Medical Coil.

H. A. S. (*Tunbridge Wells*).—As I have no time at my disposal for preparing a diagram and going fully into this matter, I shall be glad if you can understand the following brief directions. Form one part of the cover of your battery box into a switch-board by drawing a circle on it, and fixing as many brass studs in the circle as there are cells in the battery. Next have a brass lever turning on a pivot in the centre of the circle, and arranged so as to touch all the studs in rotation as it is moved around the circle. Place the cells in series, and connect one of the terminals with one of the ends of the primary wire on the coil. Connect the other end of the primary with the pivot on which the lever of the switch turns. Next connect each cell of the series by an independent wire to a corresponding stud on the switch-board. Mark the studs with figures to indicate the number of cells in the battery. If eight cells are used in series, one cell will be brought into action when the lever rests on No. 1 stud, and the whole eight will be thrown in when the lever is turned on to No. 8 stud. The current is to be reversed by a switch on the baseboard of the coil. This switch is made to send the current through the coil from right to left, or the contrary as desired. The Daniell form of cell gives the most smooth, constant, and equal current. I may add that the *Applegarth Patent Medical Coil and Battery* is a most excellent arrangement, and the current from it is all that you could desire. I do not know the price of one suited to your requirements, but the patentee would gladly reply if you address him at the Atlas Carbon Works, *Ewer Street, Southwark, S.E.*—G. E.

Cleaning Battery Terminals.

Telegraph.—Swill the terminals in dilute muriatic acid to clear off the green corrosion, then rattle them about in hot sand or hot sawdust to dry them. Whilst they are hot, treat them to a coat of paraffin wax. After they are cool clean off the paraffin from the parts where metallic contact is desired. This will minimise the trouble you mention.—G. E.

Bar Magnets.

Telegraph.—Procure round bars of good hard steel of the required size. Wind them with No. 20 cotton-covered wire, three or five layers, and put them in circuit with an electric bell connected with your battery. As the bell is being rung, the bars will be magnetized. Any other breaking arrangement will have a similar effect.—G. E.

Removal of Varnish from Negative.

Varnish.—Varnish may be removed from a negative by the application of methylated spirits. Put the negative in a clean tray and flood with spirits of wine (methylated alcohol). Let it remain in this bath for five minutes, occasionally rocking the dish as when developing. On removing the negative from the dish, the spirit must be wiped off the film by drawing some soft material—pocket handkerchief, for instance, gently across the negative. The negative will dry in about half an hour, and can then be re-varnished.

Instantaneous Shutter.

Loco (*Sohagpur*) writes:—"Referring to Vol. IV., page 332, re "Photographic Apparatus," by J. Pocock, I have made one of the Instantaneous Shutters, Figs. 41 to 50, but I find that I have to fix the focussing cloth over the slide whilst I am drawing out the shutter to expose the plate. To alleviate this I am thinking of fixing another slide in front of Fig. 45, to

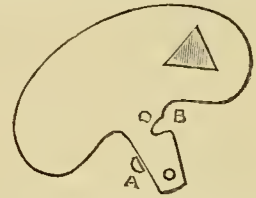


FIG. 1.—EXTRA SLIDE.

throw off with a rubber spring the opposite way to that in which Fig. 45 throws off, and made something like the sketch shown in Fig. 1, in which the stop A will allow the shutter to fall open to the full extent one way, the recess B allowing way for the pillar of the other shutter, which must

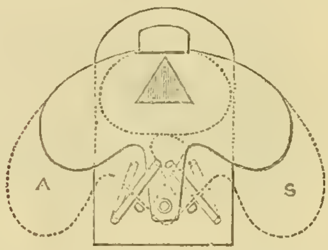
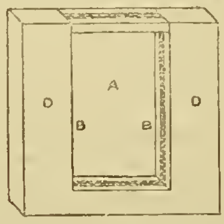


FIG. 2.—FRONT VIEW OF SHUTTER WITH EXTRA SLIDE A.

have a corresponding piece cut out as at B on the opposite side. This will allow the slides or shutters to overlap each other. The diagram, Fig. 2, shows the action of the combined shutters."

Reversible Back for Camera.

Lex.—The reversible back is only applicable to a square camera, and consists of a frame fitting into either a groove or rebate in camera, and having itself a groove to take the dark slide. The sketch will give you an idea. D D is the frame, which, being square, may be put into the camera either



REVERSIBLE BACK FOR CAMERA.

way; the opening A takes the dark slide; the sides B B being properly grooved for it; the focussing screen is hinged on at D. I am sorry I do not know the Enjalbert Camera. Perhaps some of our readers can say "how the focussing glass of this camera is carried when the screen is not in use?"—J. P.

Finsbury School of Amateur Mechanics.

J. C. (*Wood Green*) writes:—"Some eighteen months ago I saw in your Magazine an advertisement relative to carpentry, etc., etc., conducted by Mr. Syer. I put myself into communication with that gentleman, the result being that I have spent six terms with him. As other engagements will prevent my remaining for some time longer under his supervision, I should like to take this opportunity of testifying to the ability of Mr. Syer as a teacher, and to his genial disposition in the many little things that must try him, in hopes that others who, like myself, have an inclination for practical work, may know of the opportunity that is offered to them of gaining experience under Mr. Syer's tuition." [I am always glad to put in a good word for Mr. Thomas J. Syer. His classes are held at the workshops, Finsbury Square Buildings, *Chiswell Street, E.C.*, just opposite Finsbury Square.—Ed.]

Removal of Cement from Boarded Floors.

W. B. T.—In order to remove the cement—a solution of indiarubber and other ingredients—from a boarded floor which has been covered with linoleum, you might try the effect of Rendle's Electric Paint Remover, as recommended to Cliftonian. I am by no means sure that it will be effectual; if it fails owing to the peculiar nature of the cement, I am inclined to think that your only remedy lies in having the floor well scraped first of all, and then planed. But it will take some time and much labour to get through the work. The scraping must be effected with scrapers used for veneered work, or with old plane irons if you can get hold of two or three of them.

Refilling Clothes Brush with Horsehair.

W. B. G.—You say that you are "cutting every tuft of hair with the scissors as you put it in." This is the cause of failure to procure a uniform evenness of surface. The better way would be to insert the hair in every hole first, and then obtain an even surface by clipping the ends of the hair.

The "Governor" of the Steam Engine.

One Who Wishes to Know.—The "governor" is a system of revolving balls which is connected with and acts upon the throttle valve of the steam engine in such a manner as to maintain regularity of motion in the shaft, which otherwise would be accelerated if the steam was supplied in too great quantity to the cylinder, and diminished of supplied in too small quantity. This briefly is its use and purpose. Its construction will doubtless be explained by Mr. Pocock in his papers on "Model Engine Making." If you wish to anticipate his instruction I must refer you to any elementary work on the steam engine, such as Lardner's "Steam Engine," in Weale's Rudimentary Scientific Series, 1s. 6d., published by Messrs. Crosby Lockwood and Co., *Stationers' Hall Court, London, E.C.*; or, better still, perhaps to Goodeve's "Text Book on the Steam Engine," 6s., published by the same firm.

"Cabaret" Battery.

A. B. C.—I send you the description of the "Cabaret" battery. We have first a flat-bottomed glass jar A; then a thick wooden top B, in the middle of which a round hole is cut out, fret-sawed or otherwise; thirdly, a piece of leaden tube, such as is used for gas pipes, 1 inch or 1¼ inch in diameter, which is to go *tightly* in the round hole of B. The tube must be 2 inches longer than the jar when the top is on it on the lower part of it, a few holes ⅛ inch in diameter (rather less than more) must be pierced. This is the negative element, Fig. C. Fourthly, a thick (the thicker the better) cylindrical zinc, as in Fig. D, which will serve as the positive element. About an inch or so from the upper edge three holes are bored, which will receive three pieces of strong copper wire bent, as in Fig. E, the part A resting, astraddle, so to say, on the top of the jar. It is advisable to keep the zinc of a sufficient diameter so as to allow it to be just a little more than half an inch from the inner side of the jar. I should recommend also to make the top B of rather thick wood, so as the leaden tube will stand more firmly in the middle of the jar. All this being ready, the amalgamated zinc must be suspended in the jar, and then the leaden tube placed with the wooden top resting on the three pieces of wire, as in Fig. F. The jar is now to be filled with water, so as to let it come up to the middle of the zinc, and the tube must be filled up with sulphate of copper in as big lumps as possible. (A small quantity of sulphate of zinc may be added if the battery is to be made use of immediately. It requires five or six days, if not more, to get it ready if no sulphate of zinc is used. I think that it is better not to use sulphate of zinc, as a more constant and regular current will be the result.) A nice blue colour will rise from the bottom of the jar, and will stop about the lower edge of the zinc. The jar should not be moved, so as not to trouble the water when once poured in. When the sulphate of copper has disappeared from the top of the tube, more big lumps must be added, taking care lest they are too big to go right down the tube. I must not forget to say that the zinc and lead must be greased with tallow or paraffin, about one inch or so from the top so as to prevent creeping salts from wasting the whole thing. Notwithstanding all these indications, it is easy to understand that almost any broad glass, or even earthen jar will do; the zinc and tube may be smaller and shorter, as long as the general arrangement is not altered. As last information, I made four of these cells, but I think three, and, perhaps, two good-sized ones will be found sufficient.

E. W. (*Holloway*).—See reply to A. B. C.

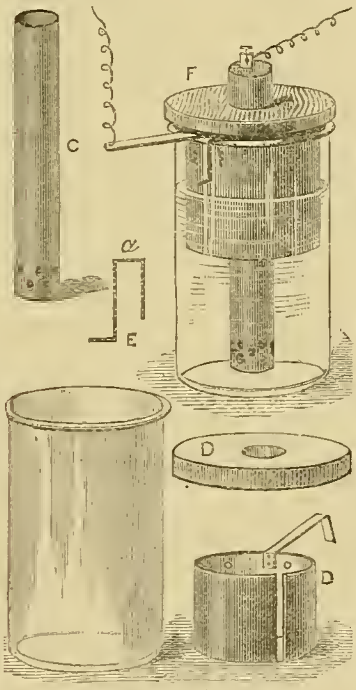
OHM.—PROFESSOR MARISSIAUX has answered your queries in his reply to A. B. C., to which I must refer you.

Electric Clock.

PROFESSOR L. MARISSIAUX points out the following errata:—In the last paragraph (page 62) there is a slight misprint; fourth line, instead of "obtain," read "bore;" as the front piece of the glass case should be bored at the required height to allow the tubes of wheels, C and D, Figs. 7 and 9, to pass through before fixing the hands on.

E. J. (*Bristol*).—For first query, see answer to L. W. W. As to the layers of wire on bobbin, I could not tell exactly how many I put; I cannot either undo it to look, but I think, as far as I can see now, there must be about eight or nine. The pinion of the connecting wheel between minute and hour wheel has seven teeth, but it would not matter if there were one or two more; besides, it depends on the size of the teeth of wheel F, Fig. 3. You cannot have more teeth on pinion than you have room to put them in. Fig. 8 gives the right size of it.—L. M.

L. W. W. (*Fitzroy Square*).—The electro-magnet being made of a wooden bobbin, it



THE "CABARET" BATTERY.
A, Glass Jar; B, Wooden Top; C, Leaden Tube; D, Cylinder of Zinc; E, Bent Copper Wire; F, Battery, complete.

must necessarily have a soft iron core; if not, how could the piece G, Fig. 4 (page 61), be attracted. As to your second query, if you will read attentively the last two lines and following of the first column (page 60), you will see that it is pretty clear; if there were two bobbins, I wonder where I could have put the second one, as there is only one hole in A, Fig. 4. See also Fig. 1. The battery I tried and found the best is described here. (See answer to A. B. C.)—L. M.

LEX.—Your questions are very numerous, but, nevertheless, according to my promise, I will answer them all. (1) See answer to A. B. C. (2) The axis B is fixed immovably in plate, Fig. 5. (3) The electro-magnet is a very ordinary one; there is nothing particular about it; it is made like that of an electric bell, but as may be seen in A, Fig. 4 and Fig. 1, there is only one bobbin. (4) The arm T may be made of brass or steel, but brass would look prettier if the whole is made of brass; besides, if you use brass, you will be able to bend it more easily to the required curve (see 2nd paragraph, 1st column, page 60). (5) The spring B is, in my clock, made of brass, which I think is preferable, as you can beat it down to the required thinness, which would be about the thickness of the supplement sheet doubled up. The end of spring B must be sufficiently thin and soft, and you will make it so by lengthening or shortening it when you screw it with its support on the board Of course, it is twisted on itself, so that one end may bear flat on the wheel, while the other is fixed by the thumbscrew. (6) See answer to E. J. (*Bristol*). (7) The two ribbons of steel which suspend the pendulum are about one-sixteenth inch broad, and should be as thin as you can get them. Take care they do not touch spring A that passes between them. (8) If you will look attentively at Fig. 3 this query will almost be answered. The axes of the hands, instead of being square, as in ordinary clocks, are round, and the ends of the tubes of wheels G and P (Fig. 3), are slightly conical (which can easily be done with a small flat file), so as to allow the hands to be fixed tightly on them. This should be done last of all, when the face of the clock is ready, for very likely you will have to somewhat shorten the tubes, and file them conical a little at a time to get the hands at the right depth. All depends on the distance which you leave between the face of the clock and wheel F. (9) The axis (Fig. 8) is fixed on wheel and moves in plate (Fig. 5) at C. (10) Axis C is fixed in minute wheel, and is, as you say, a tube fitting on axis B (Fig. 5). (11) You are not right this time. In Fig. 9 the tube is fixed in hour wheel similarly to minute wheel, but it has for its axis the tube of the minute wheel. (See Fig. 3, wheels G and F.) Fig. 3 so far as this is concerned is pretty well drawn. (12) I could not tell you where you can get wheels in England, of course; as to the cost, I am glad to say they cost me nothing, as a friend of mine, a clockmaker, made them for me; but I should think you could get them if you apply to the right place for 5s. or 6s., with their fittings. The remainder can easily be made by a *real* amateur.—L. M.

ELECTRIC writes:—"This subject I feel deeply interested in, and was anxious for the article to appear, but, alas! I cannot start to make one, for *where is the 'Energy obtained to drive the pendulum.* Of course if the pendulum is made to force the spring out of position, that spring will help to drive the pendulum back; but you cannot *gain* anything by this, only a return of energy spent in pushing it away. The whole thing smells of perpetual motion, or creation of energy, I fear." [The "energy" necessary to put the pendulum in motion is supplied by the battery, and as long as the battery is in efficient order the clock will keep going. But this is scarcely *perpetual* motion. For the rest, see replies given by M. MARISSIAUX to other correspondents. —ED.]

INFORMATION SUPPLIED.

Quick Drying Black Varnish.

LIGNUM VITÆ writes in reply to A. B.:—"A good varnish, as above, may be made as follows: Take orange shellac sufficient to one-third fill a pickle bottle, cover with methylated spirit, nearly to top of bottle, let it stand a day or two in a warm place, shaking occasionally, or if wanted quickly, stand the bottle in warm water. When using, add gas, or vegetable black to quantity required. This will dry hard in about a quarter of an hour. Brushes may be washed out in methylated spirit. In making the varnish, do not bring it near the fire or gas, or a few drops spilt may set it all on fire."

Relief Stamping in Colour.

AN OLD RELIEF STAMPER writes in answer to inquiry of J. (*Newbury*), page 96:—"To fully reply to this question would require an article to itself. Briefly, the process consists in putting the die into a kind of chuck that enables it to be lifted out of the press and replaced in exactly the same position. A counterpart is made of thick card, three pieces being generally used, the last faced with gutta-percha to enable a perfectly sharp impression to be obtained. The counterpart is trimmed close to the work with a sharp knife. The ink is generally ground as wanted with a muller in a little carriage varnish, and afterwards a small piece of it is thinned with what we used to call paper varnish to a consistency of rather thin treacle. The die is taken out of the press and brushed over with a small brush charged with the thin ink; the surface of the die is cleaned by placing the die face downwards on the top of a small pile of printing paper, and rubbing it on the surface of the paper with a peculiar twist of the wrist. The die is replaced in the press, the paper placed in position, and the plunger carrying the counterpart is sent sharply down, and the paper is thus forced into the work on the die. The inking of the die, etc., must be repeated for each impression."

H. U. (*Exmouth*) writes in reply to J. (*Newbury*):—"You must have a press, either lever or screw, the latter being the best. In colour stamping, the colour is placed on the die with a stiff brush, and then rubbed off, leaving the colour in the engraving."

Coating for Canvas.

F. Y. G. writes in reply to K. A. T. that the following will be found a very good method of coating canvas:—"Take 10 parts of linseed oil varnish and heat them to boiling point. In another vessel 3 parts of lime are to be slaked with 4 parts of water. As soon as the lime boils add 10 parts of hot raw caoutchouc. This must be stirred until thoroughly mixed. The compound is then poured into the boiling varnish, the whole being kept stirred during pouring. Then add 2 parts of ivory black. Further stir it until a homogeneous mass is formed; then strain it. The canvas is then painted while the solution is warm and hung up to dry. This coating forms a lustrous, elastic, not sticky, and waterproof covering.

INFORMATION SOUGHT.

Harmonium Chair.

LIGNUM VITÆ asks:—Will any reader kindly give me a sketch for a harmonium chair, with dimensions, to be made in walnut, with leather seat, not too elaborate?

Electric Clock.

C. C. F. asks:—Can you inform me where I might likely purchase the wheels and pinions required to construct this piece of mechanism, for, like myself, I conclude the majority of amateurs are quite incapable of cutting toothed wheels with the requisite accuracy. Will you allow me to point out what I think is a most important omission in the explanation of the mechanism—viz., what maintains the motive power in the pendulum. We all know a pendulum will not swing for ever without some force being applied to it. Mr. Pocock does not state that the check spring D is made fast to the armature, and that consequently when the pendulum is not in contact with the spring A, the pressure of D forces A rather upward, but upon contact of the pendulum and completion of the circuit, D will move with the armature towards the pendulum, allowing the spring A to impart a gentle push to the pendulum on its reverse swing being the impetus required to maintain its motion. This I should think is a delicate adjustment, but is so important that I think you will consider the propriety of pointing it out. I would make another suggestion—viz., that the upper of the two screw holes that connect spring D to the armature should be a slotted hole so as to allow for adjustment in this respect. [Clock movements for fret designs are supplied by Messrs. C. Churchill and Co., 21, *Cross Street, Finsbury, E.C.*, at prices ranging from 8s. upwards. American clocks, however, are to be purchased in any town at lower rates, and one of these might be taken to supply the necessary works. Again, old clocks may be bought for a trifling sum of dealers in marine stores and secondhand goods, which might answer your purpose as well as new works.—ED.]

G. A. F. (*Folkestone*), like C. C. F., wishes to know where to obtain suitable wheels for making MARISSIAUX'S Electric Clock. I can only refer him to my remarks above.

Watchmaking Tools.

F. A. E. (*Bailieboro*) asks:—Where can I obtain bow drills and other watchmaker's tools?

Flute Mending.

F. M. Y. (*Ryde*) writes:—"The tuning head of my flute is so split that it cannot be mended by shellac in the usual manner. In the absence of having a new wood casing to the metal, what is the best method of repairing the damage?"

Addresses of Dealers in Fancy Wood.

MUSJID writes:—"Wanted, an address where fancy wood, such as partridge, cocus, coral, laburnum, etc., can be obtained, and information as to the price of same. [Messrs. Harger Brothers, *Settle, Yorkshire*, keep laburnum in their stock of fancy woods for turning, and will supply you with this and other woods in 50 lb. parcels, at 1d. per lb.—ED.]

Type Mould.

F. A. E. (*Bailieboro*).—Is there any house of which I could purchase a type mould?

Steam Power Loom.

H. U. (*Exmouth*) asks:—Can any reader of AMATEUR WORK tell me how to make a model weaving loom to work by steam?

Collection of Fancy Woods.

NAMELESS asks:—Will any reader oblige me with the names of any rare woods suitable for a collection; and also, where I can obtain them? I should be glad to communicate with anyone on the subject. One would think that amateurs would take more kindly to the collection and classification of woods. It cannot be because it is a dull subject, as in my opinion it is more interesting than foreign stamps or coins; but opinions differ. [This correspondent writes from *Westminster Bridge Road, Southwark*. He has either omitted to give name or nom-de-plume, or his letter has reached me in an incomplete form. I have, therefore, assigned to him the nom-de-plume of NAMELESS.—ED.]

Fasteners for Boot Buttons.

COBBLER writes:—"Will any reader of AMATEUR WORK inform me where I can obtain 'Wright's Patent Excelsior (or Climax) Button Fasteners?' I got some about two years since, and have not been able to purchase any since in this neighbourhood (*South Yorkshire*). They are the best thing of the kind I have seen for boot buttons."

Varnish for Patterns.

H. T. asks:—Will any reader kindly tell me what kind of polish it is that pattern-makers use for patterns?

Spencer's Instantaneous Polish.

BASS writes:—"As I have so often seen Spencer's Instantaneous Wood Polish advertised, and with so much flourish, I resolved to try it. So I got a bottle, and used it according to the directions—that is, by damping a piece of wadding and rubbing it on the work, and I cannot make it answer so well as it is said it will. It leaves the work streaky, and in some cases takes all the polish off again. Can anyone tell me better how to use it, for if it will not produce a better effect than that, it is not worthy of the merit it claims over the ordinary French polish, nor is it nearly so good?" [What you wish to discover is the cause of your failure to make a good job with the polish; and this, I think it will be difficult for anyone to determine. The maker is Mr. Robert Hampson, 205, *St. John Street Road, London, E.C.*, and I think you had better write to him and point out your difficulty—stating clearly the conditions under which the polish was used, and kind of wood to which it was applied.—ED.]

COMMUNICATIONS AWAITING REPLY

MR. JOHN HENDERSON; G. S. N. (*St. John's*); H. T. M. (*Balham*); F. M. Y. (*Ryde*); A WOULD-BE MAKER; C. T. (*Dover*); IGNORAMUS; G. A. T. (*Folkestone*); F. W. (*Brixton*); FLOWERS; SAVANT; SCHOOLBOY; H. W. (*Glasgow*); N.E. SIGNALMAN; S. W. (*Urmston*); AJAX; INCEPTOR; HONG-KONG; C. C. (*Stratford, E.*); A. S. (*Earlsfield*); C. R. T.; J. C. (*Leeds*); A. Y. S. (*Waterford*); H. S.; MABUTA; W. F.; FLASHING DYNAMO; W. R.; F. F. McK.; R. A. W. (*Dublin*); W. H. R.; BURTON FLEMING; D. B. A.; Rev. R. J. SIMPSON; BOX; H. S. B. (*Dublin*).

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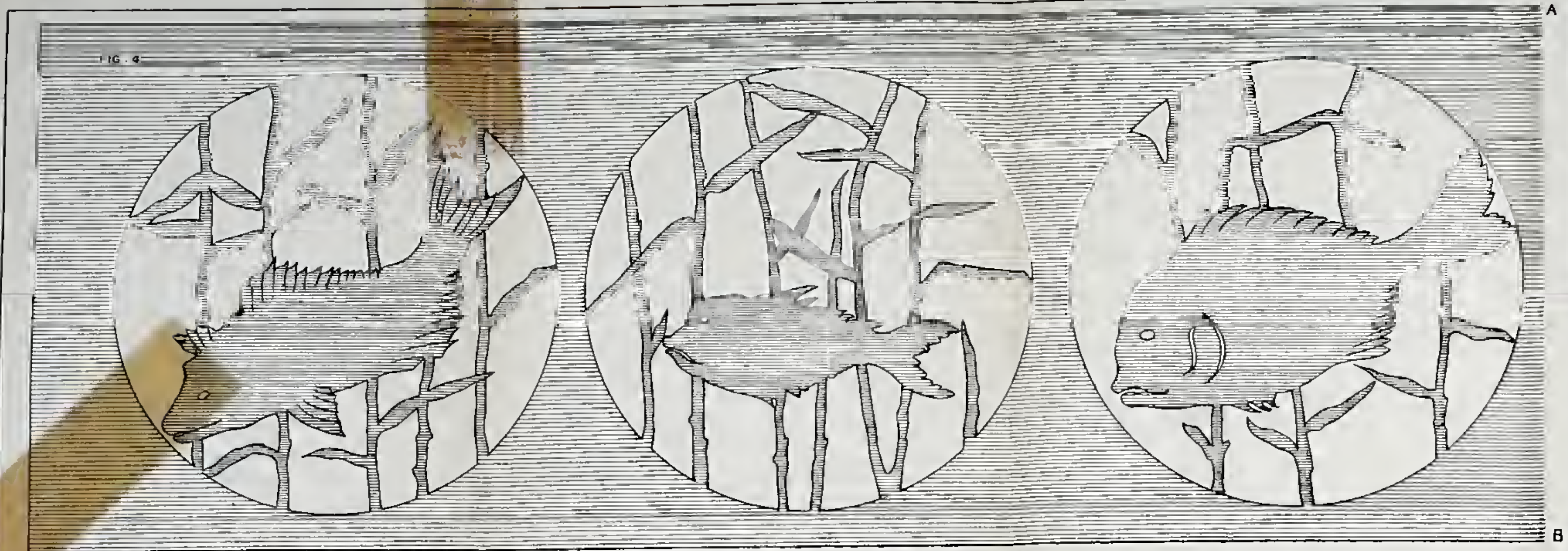
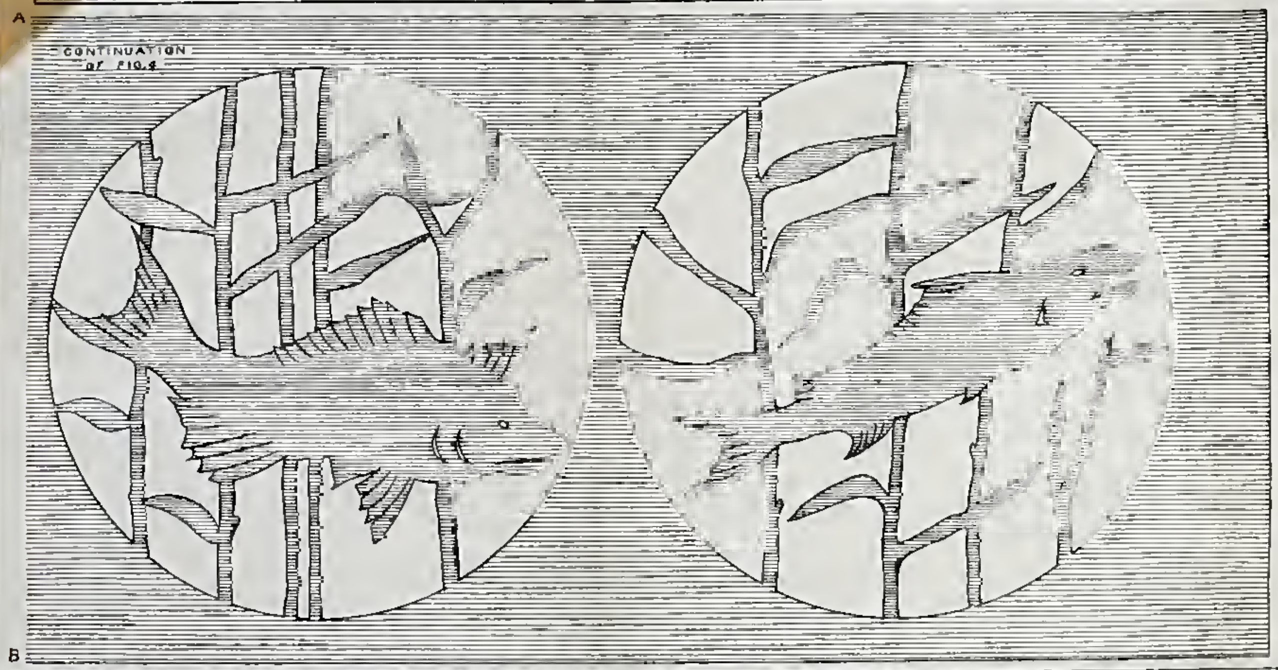
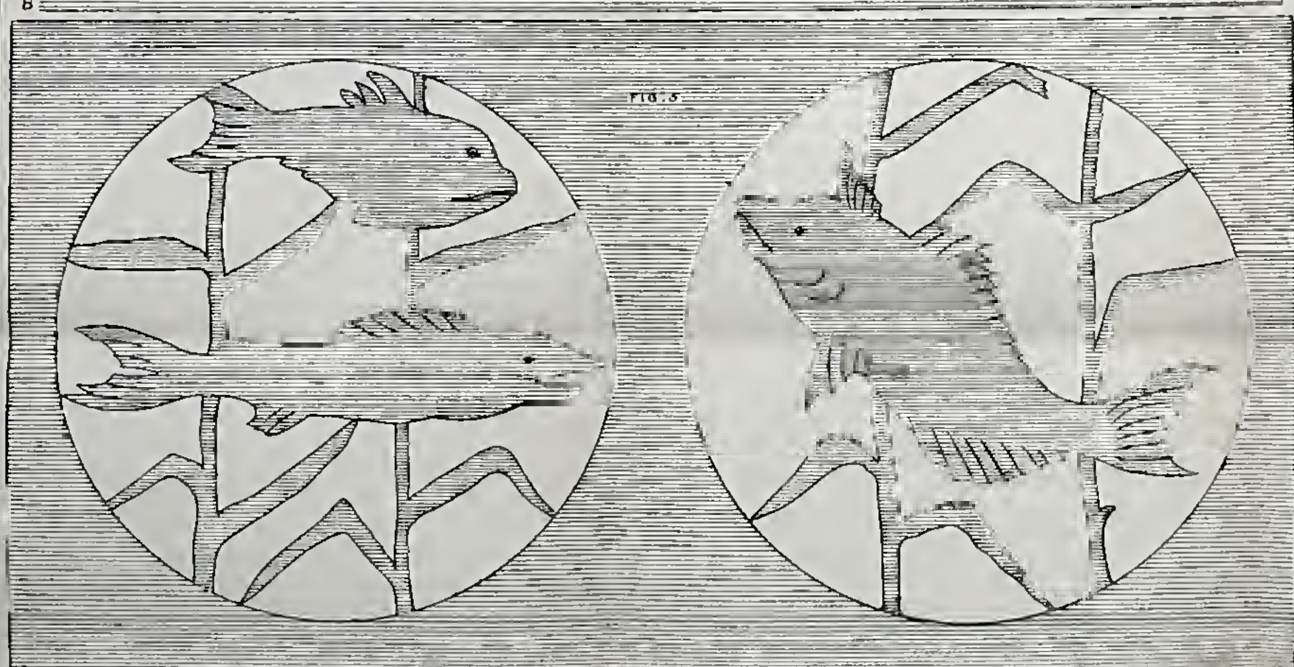
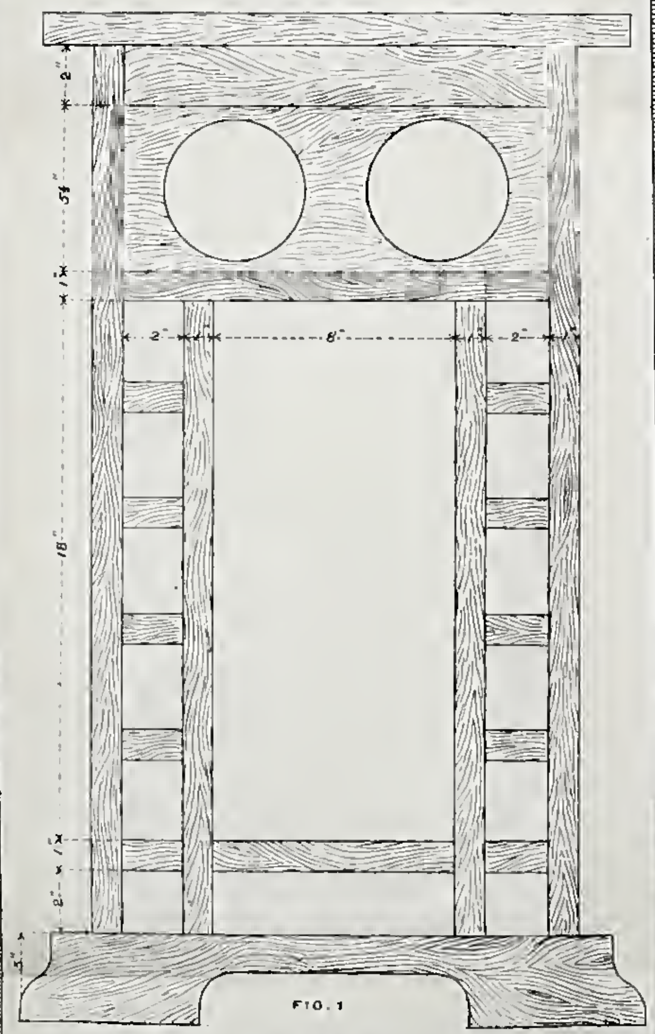
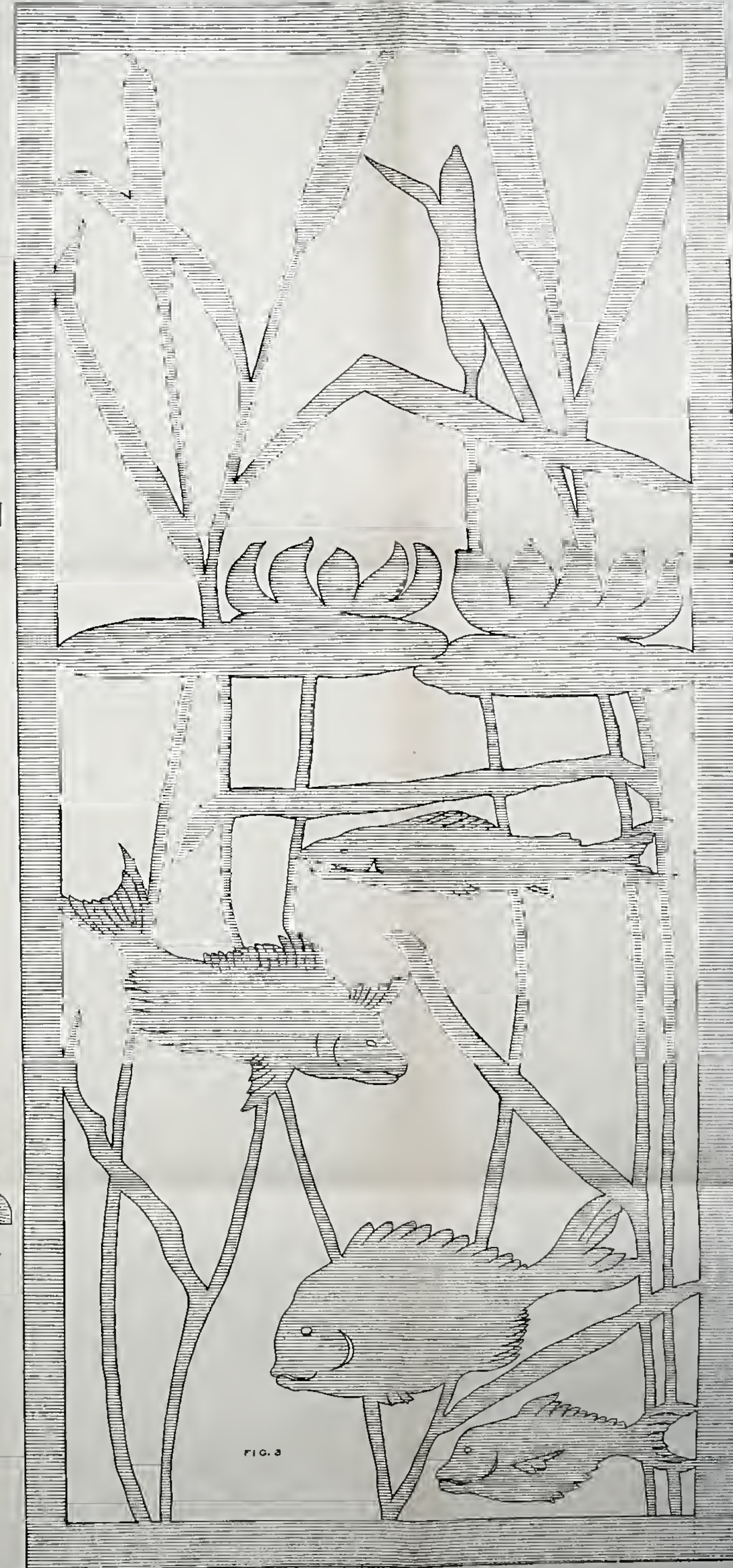










THE FISHES TABLE OR STAND FOR AQUARIUM

WITH FRETWORK PANELS

DESIGNED FOR AMATEUR WORK ILLUSTRATED.

BY

J. W. GLEESON-WHITE.

Fig. 1.—End Elevation of Table, showing construction of Framework.

Fig. 2.—Part of Front Elevation, showing end to right hand.

Figs. 1 and 2 on scale of 3 inches to 1 foot.

Fig. 3.—Fret Panel in end of Table.

Fig. 4.—Fret Panel for Front Rail (in two parts, A B showing line of junction of parts).

Fig. 5.—Fret Panel for End Rail. Length 14 inches.

WARD, LOCK, AND CO., WARWICK HOUSE, SALISBURY SQUARE, LONDON, E.C.

UNWIN BROTHERS, PRINTERS, 77A, LUDGATE HILL, E.C.


A

A HOME-MADE PRINTING PRESS.

By FAUST.

ON reading the very clear and concise articles on "Printing," which recently appeared in this Magazine, I was seized with a desire to do a little home printing. And as the first and most important requisite was a Printing Press, I at once set about getting as many price lists and catalogues of amateur presses as I could possibly lay hands on. After a careful study of them all, I found that unless I purchased a mere toy, the majority of them which were capable of doing good work were beyond the capacity of my pocket, and had almost decided to wait until I had advanced a step or two nearer the enviable condition of being a millionaire, when the idea struck me, Why not make a press? So after much studying of the illustrations of the various makes, I finally sat down, drew a working plan, purchased the materials, and commenced in real earnest: with what success I will endeavour in this paper to show.

And before proceeding let me say that those who would follow my example must make up their minds, before beginning the work, to do it carefully, and with as much accuracy as time and patience will permit of, for without this care, no real good work can be done in making a printing press; and any extra pains will be well repaid in a good working machine, which will, for all practical purposes, turn out work equal to one costing as many pounds as this will cost shillings, as the specimens sent to the Editor will show. [These specimens were excellent.—ED.]

I decided that the press I made must be capable of printing a sheet 10 inches by 8 inches, a size which is sufficiently large for most amateurs; and as it requires a pressure of about 120 lbs. to the square inch to give a good impression, I saw that the eccentric lever would be at once the simplest and the best mode of applying the pressure; and to prevent the platen giving way in the centre, a fault of all amateur wooden presses, I strengthened it with three transverse bars, in such a way as to make it perfectly rigid, so that it would not give way under the heaviest pressure that could be applied.

FIG I

FIG 3

A B

FIG 5

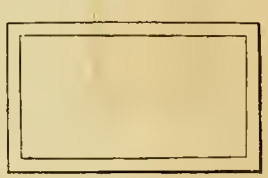


FIG 2

FIG 4

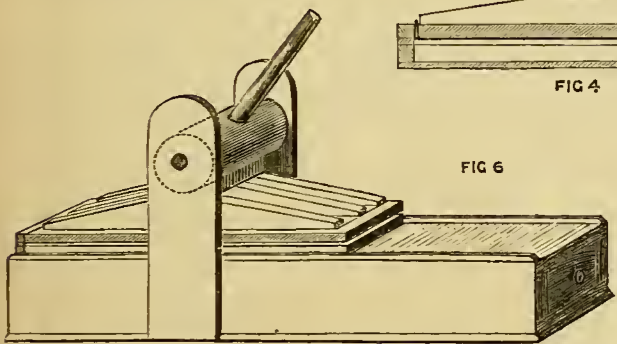


FIG 6

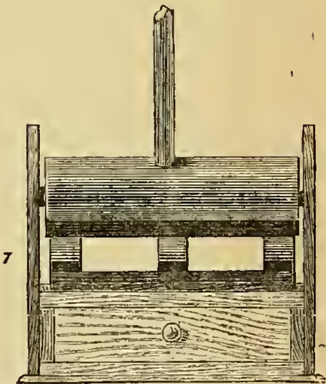


FIG 7

FIG. 1.—SECTION OF FRAME OF HOME-MADE PRINTING PRESS. FIG. 2.—FRAME OF CARRIAGE. FIG. 3.—PIECES FOR TOP OF PLATEN. FIG. 4.—CARRIAGE COMPLETE, SHOWING HINGING. FIG. 5.—FRONT ELEVATION (A) AND END ELEVATION (B) OF IMPRESSION ROLLER. FIG. 6.—PERSPECTIVE VIEW OF PRESS, COMPLETE. FIG. 7.—END ELEVATION OF PRESS.

Procure, then, from the nearest woodyard, the following pieces of good clean yellow deal, as well seasoned as possible, and free from all knots and shakes:—

- 2 pieces for sides, 2 ft. by $4\frac{1}{2}$ in. by 1 in.
- 2 pieces for end and centre, 10 in. by $4\frac{1}{2}$ in. by 1 in.
- 1 piece for bottom, 1 ft. 2 in. by 24 in. by $\frac{5}{8}$ in.
- 1 piece for top, 1 ft. by 24 in. by 1 in.
- 2 pieces for drawer sides, 1 ft. 4 in. by $4\frac{1}{2}$ in. by $\frac{5}{8}$ in.
- 1 piece for drawer front, 10 in. by $4\frac{1}{2}$ in. by 1 in.
- 1 piece for drawer back, 10 in. by $3\frac{1}{2}$ in. by $\frac{5}{8}$ in.
- 1 piece for drawer bottom, 1 ft 4 in. by 10 in. by $\frac{5}{8}$ in.
- 2 pieces for guides, 2 ft. by 1 in. by $\frac{1}{2}$ in.

Also get the following pieces of good sound straight-grained mahogany:—

1 piece for platen, 9 in. by 11 in. by 1 in.
1 piece for bed of carriage, 9 in. by 11 in. by $\frac{5}{8}$ in.
2 pieces for sides of carriage, 1 ft. by 1 in. by 1 in.
2 pieces for ends of carriage, 9 in. by 1 in. by 1 in.
1 piece for hinging platen, 9 in. by 1 in. by 1 in.
3 pieces for bars on platen, 10 in. by 2 in. by 1 in.
1 piece for impression plate, 9 in. by $2\frac{1}{2}$ in. by 1 in.
2 pieces for uprights of roller, 1 ft. 3 in. by $4\frac{1}{2}$ in. by 1 in.

Put these pieces on one side until required; and now, having got the wood, and your tools in good working order, you can make a start.

Plane up the two side-pieces, and the pieces for the end and centre; see that you keep them true, and square on the edge. Cut the two side-pieces exactly 23 inches long, and square up the ends on the shooting board, or with the plane, if you have not got a shooter; cut one of the short pieces $10\frac{1}{2}$ inches long, and the other 9 inches. Take the two side-pieces and dovetail them and the $10\frac{1}{2}$ piece together; but, before glueing together, cut a reglet or groove across the two side-pieces, on the inside, and six inches from the dovetailed end; this groove must be $\frac{7}{8}$ inch wide, and into it slip the short piece, and put a couple of nails through from each side. This piece is for the purpose of giving a greater resistance to the pressure which is applied in working the press. A reference to Fig. 1 should make the whole of the foregoing description quite clear.

Now take your bottom piece, plane it up on both sides, and cut it to $11\frac{1}{2}$ inches long and 24 inches wide, round the edges and ends, as shown in Fig. 2. Nail it on to the frame, letting it project $\frac{1}{2}$ inch all round. Now plane up the top piece, cut it to $10\frac{1}{2}$ in. long and 23 inches wide, and nail it on in the same manner as you did the bottom, only keeping it flush with the frame all round. A touch of warm glue, or Le Page's Carriage Glue, before nailing on these pieces, will be an advantage.

These two pieces for top and bottom you will observe from their dimensions are cut the cross way of the wood; this is to render your frame stronger than it would be if they were put on lengthwise.

Having completed the frame, you can now take your mahogany and plane it up true and square, especially the pieces which are to form the bed and platen of your machine, and these two pieces you must accurately gauge to thickness, as, if not done properly, you will find that the impression will not be regular when you come to work the press, and will cause you a lot of trouble and loss of time in "making ready" your jobs

Take the four pieces 1 inch square, and plane them to $\frac{3}{4}$ inch square. Cut two of them to $10\frac{1}{2}$ inches long, and the other two to $8\frac{1}{2}$ inches long, dovetail them together in the form of a frame, glue together, set square by measuring from corner to corner, and set aside to dry. Cut the $\frac{5}{8}$ inch piece, which is to form the bed of the carriage, to $10\frac{1}{2}$ inches long, by $8\frac{1}{2}$ inches wide, screw it on the frame with $1\frac{1}{2}$ inch No. 12 screws, countersinking the heads well into the wood.

The platen now demands attention, and to complete this you must procure another piece of mahogany, 9 inches long and 1 inch square. Strip up your platen to 9 inches long and $10\frac{1}{2}$ inches wide (cross wood again, you see), and hinge it to the smaller piece with a pair of $2\frac{1}{2}$ inch brass edge-hinges, as shown in the figure.

Now get two pieces of No. 12 zinc, 9 in. by 7 in., screw one of them flatly down to the inside of the carriage, and the other to the centre of the platen, taking care to keep the screws well to the sides, so as to be out of the way of the type; $\frac{1}{2}$-inch screws will do for this, and on no account put any screws in the centre, or away from the edge. Get four types, and place them on end, one at each corner of the carriage, resting on the zinc plate, and lay your platen carefully on the top of these; let it project a little at each side, but keep it flush at the hinged end. You will now see that there is a little space between the bottom of the hinged piece on the platen and the frame of the carriage; into this fit a slip of wood accurately. This will bring your platen exactly to type level; put down four 2-inch screws through the hinged piece into the frame of the carriage, as shown in the drawing; then put a brass or wooden knob on the front end of the carriage, which will do to pull it out and in with. Plane up the three pieces for the bars to $1\frac{3}{4}$ inches wide, cut them to 10 inches long, and taper them away at each end to $1\frac{1}{4}$ inches, leaving a flat piece in the centre of about 3 inches. Screw one on to each side of the top of the platen, keeping them in about $1\frac{1}{2}$ inches from the edges, and the other in the centre. Take the impression piece, plane it up, and cut it to 9 inches long. Screw it down to the flat piece on the top of the bars, and now your platen will be as rigid almost as if it were made of cast iron. In putting in the screws in these bars, put them through from the inside of the platen, keeping their heads exactly flush with the wood.

You must now pay a visit to the turner, if you are not the happy possessor of a lathe, for the impression-roller requires to be turned very accurately; and I would suggest that you just wait beside the turner while he does the job, and see it done to your satisfaction, as I had three rollers spoilt before I managed to get my idea into the workman's head. This roller should be of mahogany, beech, or birch, preferably

mahogany, and will have to be of the form shown in the figure, $10\frac{1}{2}$ inches long, 3 inches in diameter, with two pins at the ends, 1 inch long, and 1 inch in diameter. These pins must not be in the centre, but a quarter of an inch off the centre, as in the figure, and on the accuracy of the centreing of these pins much of the working of the press depends. So you must see that they are carefully done to pattern.

You will also want a turned handle, or lever, which must be 12 inches long, with a pin at the end, 2 inches long and $\frac{7}{8}$ inch in diameter.

Take the two pieces for the uprights, plane them on both sides, square one end, and $4\frac{1}{2}$ inches from this end form a check, as in the figure, a quarter of an inch deep. This being done, take the frame of the press, and lay the carriage upon it, keeping it flush at the closed end of the frame. Lay the roller on the top of the impression piece, and place the two uprights in position, with the pins as shown. Apply a square across the uprights, and mark where the centre of the pins come to, bore the holes in the uprights with a clean sharp centre-bit, put in the roller, and screw the uprights into their places, taking care that the roller falls exactly on the centre of the impression-piece. You can now round off the top ends of the uprights, or leave them square, according to taste.

Next bore a $\frac{7}{8}$ inch hole in the centre of the roller, and insert the lever, glueing it firmly into its place. You can now apply any pressure you please to your platen, according to the job you may be printing, and before you finally fix the uprights in position, a little grease applied to the roller pins will much facilitate their working.

Now the two long slips which we have left till the last may be taken and planed up all round; round them a little on one edge, cut them to 23 inches long, and fix one on each side of the frame of the press, so that the carriage may slide smoothly and easily between them. Then screw them down with $\frac{3}{4}$-inch screws.

You can now make and fix in your drawer in the frame of the press, and will find it very useful for holding your roller, ink, etc.

The press is now finished, and if appearance is an object, will be wonderfully improved by your staining the white wood to match the mahogany, and giving the whole a coat of oak or spirit varnish. Put a couple of sheets of paper on the platen, and you are ready for work.

In conclusion, the cost of the materials for my press was as follows :—Yellow deal, 3s. 3d.; mahogany, 2s. 9d.; zinc, 9d.; one pair $2\frac{1}{2}$-inch hinges, 6d.; turned roller and handle, 1s. 6d.; knob for carriage, 2d.; knob for drawer, 1d.; stain and varnish, 6d.; nails and glue, 5d.—total, 9s. 9d.

HOW TO PACK PICTURES FOR TRANSIT.

By H. C. STANDAGE.

II.—PACKING SEVERAL PICTURES IN ONE CASE.

WE may now consider the circumstance of having several pictures to pack in one case, and that the picture frames are of diverse sizes. It is obvious that we can only utilize two sides of the case—the top or inside of lid, and bottom of case, for the insides of the ends of the case cannot, under any circumstances, be used to fasten picture frames to.

Now under our present circumstances we have several things to consider ; first of all, we must gauge the spaces at command by trying the picture frames in the packing-case to ascertain whether they can be all got into the available space without fear of damage to either pictures or frames. Taking it for granted that the case is large enough to hold all the pictures, say there are seven—we must next consider the best way to arrange them, whether to pack the small ones on the lid and bottom of case, and the larger ones on battens, or vice versa. It is best, to ascertain these facts, to try the pictures. Supposing it is found that the insides of lid and bottom of case will take five pictures, and that the two largest can be "swung" on battens between them, under these circumstances proceed fastening on the five small ones first.

Say the packing-case is 6 feet long and 5 feet broad, inside measurement, and 1 foot 9 inches deep, and that the arrangement shown in Figs. 9 and 10 is the best suited. We also found that the biggest picture, which is 5 feet 9 inches square, must have a space of 4 inches left between the sides of the case and the portion fastened to the bottom on account of its wide and deep moulded frame, we must therefore keep the three pictures, A, B, C, at least $4\frac{1}{2}$ inches from the side, but in the case of B, as that frame is a very deep one, it has to be kept more than 4 inches—in fact, so arranged in position as to go inside the moulding of the frame of the biggest picture.

Proceed to screw on C first. Stand the packing-case on its side, Z Z, put two blocks of wood $4\frac{1}{2}$ inches thick for C to rest on, centre the frame between the length of the case, that is even equal space between each end and the sides of the case—in this case there is $7\frac{1}{2}$ inches at each end (6 feet less 4 feet 9 inches= 1 foot 3; and 1 foot 3 ÷ 2=$7\frac{1}{2}$ inches) ; all these calculations are quickly prepared by the aid of a two-foot rule. Stand the picture C on the block, and let a second person hold it in that position while you screw it to the packing-case.

Now, as the screwing has to be done from the outside of the packing-case, the position for each screw

must be accurately calculated, otherwise you run the risk of boring the gimlet through the canvas or else the thin part of the frame if it be a concave moulding.

Fig. 11 explains these points at a glance. Say the frame of C is 3 inches wide, and that it is thicker at the outer edges and slopes off to a thin wedge shape towards the "sight," or picture margin. In this case, if the screws are placed too near this thin edge they might come through the front of the frame, or the gimlet might be bored too deep, but we find, however, that half way between—*i.e.*, 1½ inch from the edge of the moulding, there is thickness enough for the screw to enter ½ an inch, we therefore, select that spot for each screw. Now, when the person who puts in the screws is behind the packing-case he cannot know this spot only by calculating, and this he performs thus:—the wood of the case is 1 inch thick, the space between outside edge of frame and inside edge of case is 7½ inches, the distance the screw is to be from the outside edge of the frame is 1½ inch; consequently the total of 10 inches from the outside edge of packing-case will indicate the precise spot, for the screw to enter frame (always proceed to put in the side screws first in preference to the top and bottom ones). In the case of the screws in the bottom of the frame, similar calculations have to be made. Thus the case is 1 inch thick, the space between frame and case is 4½ inches, and the screw is 1½ inch from the outer edge of the frame—total 6 inches from the bottom edge of the packing-case for the screw holes to be bored.

The position for the screws in the top of the frame are also calculated as for the bottom edge plus the width of the picture; thus, thickness of case 1 inch, width of space between 4½ inches, width of picture 2 foot—total, 2 foot 5½ inches; this brings us to the top edge of the frame C, but as the screw hole is to be 1½ inch below this edge we must deduct 1½ inch from this amount, consequently 2 foot 4 inches from the bottom of the packing-case will be the correct position to bore for the screws. The number of screws necessary for a picture the size of C would be six—one in each end and two top and bottom of frame; the screws in the latter case being about 9 inches in from the end of the picture frames so as not to start the mitres. A sure method of calculating for the screwing in all the pictures that are put in the bottom of the packing-case, has to be followed; the three items to take into account are the thickness of the woodwork of the case, the space between inside of case and outer edge of frame, the number of inches from the outside edge of frame for the screw to enter the frames without risk of boring through it.

In the case of the pictures that are screwed to the lid, they have to be screwed on from behind, when they are not placed on battens; but in this case no allowance has to be made for the thickness of

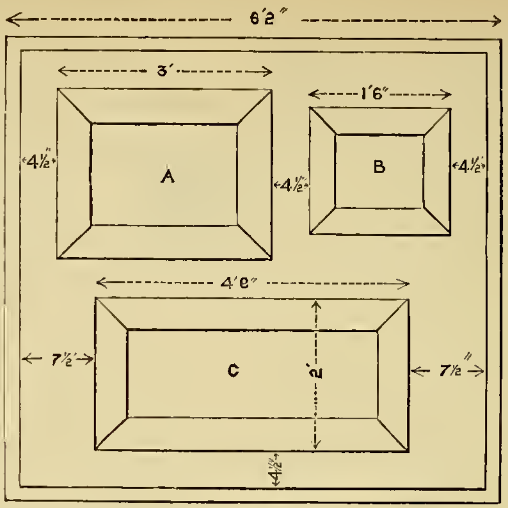


FIG. 9.—PICTURES ON BOTTOM OF CASE.

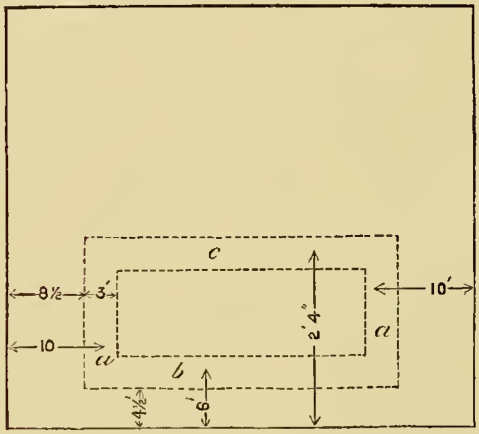


FIG. 11.—DIAGRAM SHOWING MODE OF SECURING PICTURES.

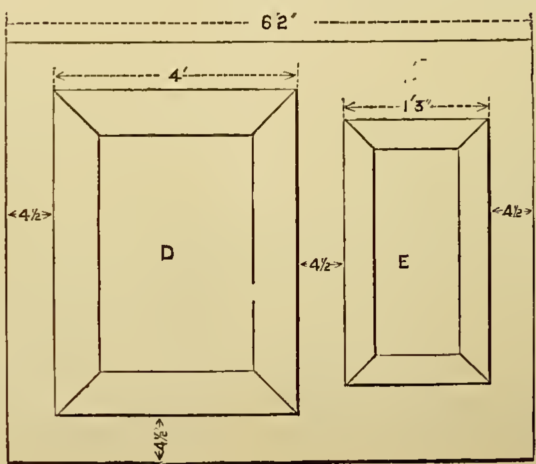


FIG. 10.—PICTURES ON TOP OF CASE.

any wood, because the number of inches the outside edge of the frame is from the edge of the lid is the same back and front. Take an example: the frame D has to be $4\frac{1}{2}$ inches from the edge of the lid, and the screw enters the frame $1\frac{1}{2}$ inch from the edge of the frame, consequently if the hole be bored 6 inches from the outside edge of the packing-case lid, the correct spot will be reached.

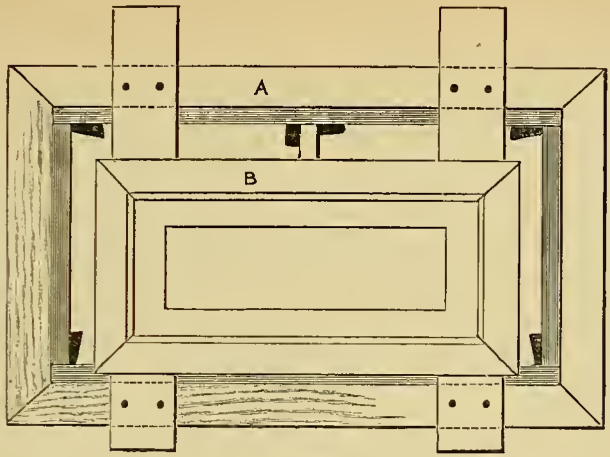


FIG. 14.—TWO PICTURES OF DIFFERENT SIZES IN ONE CASE.

Instead of blocks of wood to rest the picture frames on, two wedge shaped pieces (shown in Fig. 12) are preferable, because they can be driven up tight, and also loosened easily, when a solid block of the greatest dimensions is often found to be wedged in tight after the screwing has been done, and if the ornament of the frame overlaps the edge of it, as in many composition frames it does, there is difficulty and always risk of breaking this ornament when wriggling the block to get it out, and it would not do to leave it in the packing-case because it might become loose subsequently, and thus falling about from place to place by the packing-case being turned over, would do irretrievable damage to paintings and frames.

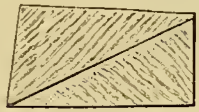


FIG. 12.—WEDGE SUBSTITUTED FOR BLOCK.

We have now to consider how to pack the two largest paintings. The position these two pictures hold in the packing-case is a peculiar one, for they are suspended as it were between the pictures packed on the lid and bottom of case, and necessarily under such circumstances the necessary measurements must be very accurate. This can only be secured by planning them out before even a screw is put in.

In the first place the depth of the packing-case must be larger than the total thickness of the frames that now lie parallel to each other. In the present example the thickness of the deepest frame on the lid, and of that on the bottom of the case must be added to the total thickness of the two suspended frames and the battens to which they are joined, and to the total thickness thus obtained, 2 inches more in depth

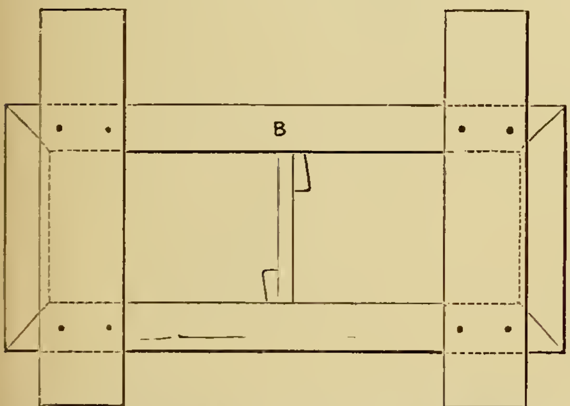


FIG. 13.—PREPARATION OF SMALLER PICTURE, AS IN FIG. 14.

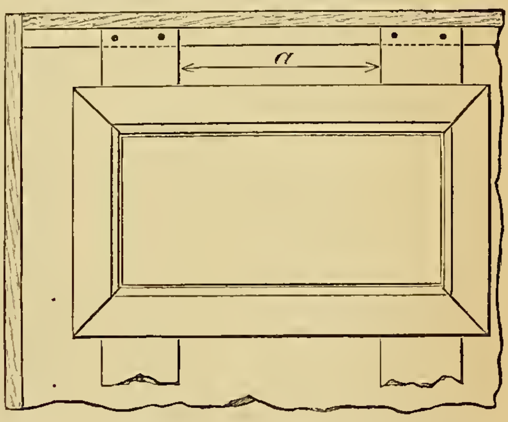


FIG. 16.—ATTACHMENT OF ENDS OF BATTENS TO CLEATS.

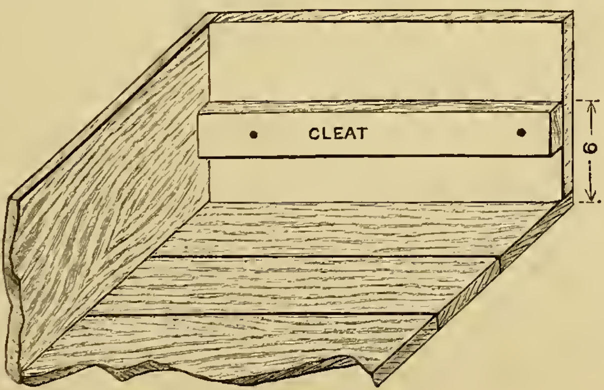


FIG. 15.—DISPOSITION OF CLEATS IN PACKING PICTURES.

must be allowed in the packing-case, viz., 1 inch space must be between the paintings screwed to the bottom of the case and the suspended picture that faces them, and 1 inch space must also be allowed between those frames on the lid and the suspended picture that faces them.

In our present example the method of securing the pictures to the battens is somewhat different to those given in previous examples. Let the size of the largest pictures (of course the outside measurement of the frame is here included) to be suspended on battens be 5 feet 9 inches, and that of the other to be 4 feet. When the sizes are so dissimilar as this one pair of battens will suffice to hold the two pictures, as shown in Figs. 13 and 14.

Start with the smaller of the frames B, and screw it to the battens in the way already described; then lay the larger picture A face downwards, and lay the batten to which it is screwed on it, as shown in Fig. 14.

Two screws in each case will be required. In Figs. 13 and 14 B is represented as being nearer one end of the batten instead of midway between the ends. This is to enable B to face the two pictures A and B, of Fig. 9, instead of facing all three (A, B, C). Now to secure the battens in the packing-case, "cleats" or strips of wood must be screwed inside the packing-case, two cleats are necessary, and at opposite ends of the case.

These cleats are for the ends of the battens to rest on, the height at which they are placed must be gauged by the thickness of picture frames that are between the battens and bottom or lid of packing-case. This point is illustrated in Fig. 15. Supposing the thickness of the picture frame that is screwed to the bottom of the packing case is $2\frac{1}{2}$ inches, and that the frame that faces it, and is suspended on battens, is also $2\frac{1}{2}$ inches, to allow of an inch between the *top* of the cleat must be 6 inches from the bottom of the packing-case, as shown by the arrow, Fig. 15. This cleat is screwed inside the packing-case before any pictures are put in to prevent the risk of any tool dropping and injuring the pictures, etc.; in some cases, however, they have to be put in after, such, for instance, as when the pictures that are to be secured to the bottom of the packing-case leave very little margin between their frames and the sides of the packing-case. Remember always to measure from the *bottom* of the packing-case to the *top* of the cleat.

Fig. 16 shows how the ends of the battens are secured to the cleats. The battens holding the pictures are lifted into the packing-case very carefully, and the ends rest on the cleats as on a ledge; two screws are then put diagonally through the ends of each batten, through the cleat and into the sides of the packing-case, the object of putting the screws in *diagonally* instead of perpendicularly into the cleat, is to prevent them being torn out of their screw holes by the bumping and jolting which the packing-case will undergo in transit. A cleat $1\frac{1}{2}$ inch wide and 1 inch thick will be of a size sufficient to support an extraordinarily heavy picture.

"Cleat" should more properly be the term applied to short blocks instead of a long strip of wood. In some cases these short cleats are not only more convenient but absolutely indispensable.

It is not absolutely necessary that the two pictures, A and B, Fig. 14, should be secured to the same pair of battens—in fact, should they be the same size or only an inch or two different, one pair of battens could not be used for them, because there would be no means of screwing on the second picture. Consequently, in this instance of the frames being equal in size, two pairs of battens should be used—one pair for one picture and another for the second, but the battens should be so arranged as to allow one pair to fall inside the other pair when secured to the cleats. Thus in Fig. 16, the battens holding the picture that faces the bottom of the case could be placed so as to go inside the space (*a*) between the battens holding the topmost picture.

Should any reader require more details, or explanations as how to deal with special circumstances, I will most willingly give them if he send full particulars as to measurements of frame, packing-case, etc.

THE "FISHES" TABLE, OR STAND FOR AQUARIUM.

A PRETTY PIECE OF FURNITURE FOR FRETWORKERS.

By J. W. GLEESON-WHITE.

(*For Illustrations, see Folding Sheet issued with this Part.*)

IN former parts of AMATEUR WORK, Illustrated, various designs have been given for constructing pieces of furniture, wherein fretwork is made the chief feature, the more usual form for that art being either small comparatively useless trifles, or if used in furniture, applied as an ornament in very small quantities. This last may possibly be in the better taste, but there are many amateurs who have hardly sufficient skill for the higher class of cabinet work, where the fretwork is only a little extra detail, but who are yet able to cut the work itself excellently well, and are carpenters enough to fit a simple structure whose chief end is merely to render the fretwork sufficient support and strength to give that somewhat fragile material the chance of holding its own in the battle of the survival of the

fittest; otherwise, worked as it is, for mere ornament, all the strength that the thin wood panel possessed in the first place, is lost, and it has rarely cohesion enough to bear the final fitting together, and when the heavy hand of fate, otherwise the maid-of-all work, grimly approaches, duster in hand, the mere tread of that stern apparition shakes it to a tottering downfall, which the actual touch of the duster catching in all its peaked parts speedily completes. This is no fancy picture, as boxes full of boyish fretwork, waiting that spare day to mend, which never arrives, bear witness in many a household, yet while having no great liking for the smaller dust collectors which have done their best to bring the art of fret-cutting into disrepute; yet honest work, if it be only a schoolboy's, is always too good to be lost, and should have power not only to afford pleasure to the worker at his work (a necessary part, it is needless to say, of all labour that is done *con amore*), but should last to give others the pleasure of the work, and to add a little variety to the more enduring, if plainer furniture of every day life.

In this table the extreme simplicity of table construction has, I think, been reached; and although I am somewhat doubtful if the attempt to give lightness to the work has not rather dangerously encroached upon its strength in the chief support, the four legs; yet if they are so, it will, I think, be sufficient to enlarge these a trifle without altering any of the other measurements; but if the size be adhered to, it is important that a harder wood than common deal, or even the softer mahogany is chosen.

The drawing to scale, exhibited in Fig. 1, shows clearly the construction of the table itself, the fretwork panels being rebated into the spaces prepared for their reception. All the other woodwork mortised in ordinary fashion. The two lower rails should be fitted in the centre of the table to be less in the way of feet in passing. The lower part of the foot may be cut in a solid piece of 2 inch stuff; but five minutes' study of an ordinary occasional table of this type will show the needful fitting better than pages of description.

The top of the table should be, if possible, of more than one piece of wood, as no matter what the wood may be, if used in a slab, it almost invariably cracks or warps. If skill is available, the circles of the pattern inlaid into the top would greatly add to the effect, or if traced with carbon paper on light wood, and the parts to be cut out in fretwork, painted with Stephens' ebony or rosewood stain, a very similar effect is gained with little trouble; in fact, if so preferred, all the top rail pattern may be as successfully used in this way as if done in fret-cutting.

The wood for the whole is optional, as in the other pieces of fretwork furniture. It is more economical to ebonise the whole, using various woods, as chance or the necessity of the work suggests; but if mahogany is used, it should be well darkened, while oak may be left uncut. But in any of the former articles on similar work, suggestions will be found that renders it needless to repeat them at length here, especially as the pages of "Amateurs in Council" are always open to explain any detail that has been either overlooked or inaccurately described.

MODEL ENGINE-MAKING.

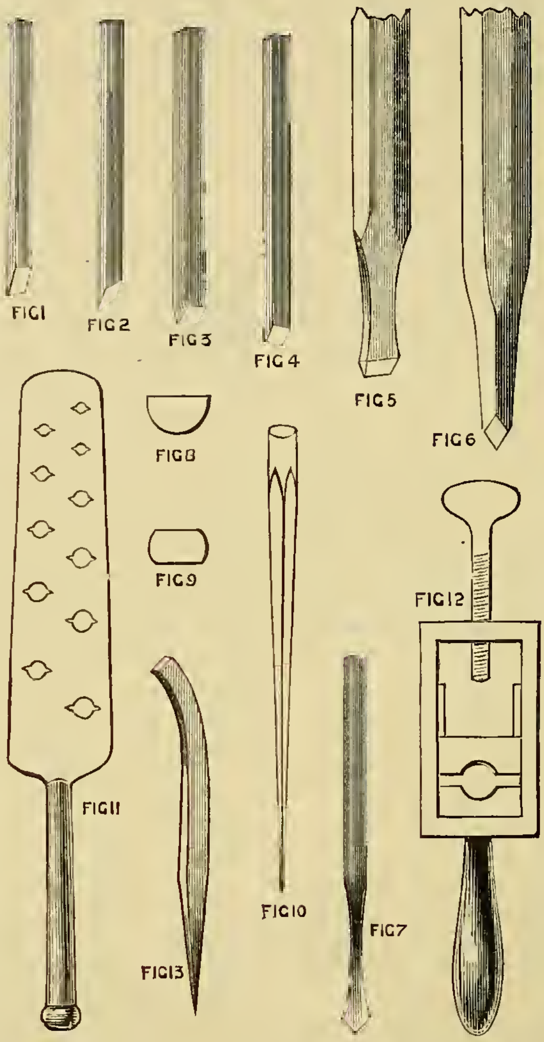
By JOHN POCOCK.

I.—INTRODUCTION—WHERE TO BUY CASTINGS.

THERE are many people who, never having tried their hands at model engine-making, maintain that such work is a mere waste of time; but, as a matter of fact, there are few leisure occupations better calculated to train the hand, eye, and mind, all at one and the same time, and to such good effect. Not only does it afford a most thorough training in all descriptions of such mechanical work, as lie well within the compass of an amateur's powers, as filing, drilling, turning, fitting, screw-making, etc.; but a considerable amount of knowledge is also acquired as to the theory and practical application of steam—the most important power of the present day Nor must it be forgotten that James Watt, himself, although he had previously, by means of a Papin's digester and a syringe, made a few experiments as to the practical application of steam, might nevertheless have failed to turn his attention so seriously to the improvement of the steam-engine, had it not been for the model engine placed in his hands for repair by the authorities of the College of Glasgow; and while we continue to obtain from the steam-engine, as at present, only a small proportion of the energy theoretically contained in the fuel consumed under the boiler, who can say but that the model-maker of to-day may be a second James Watt to-morrow?

We must, in the outset, admit that model engines cannot be exactly like their larger prototypes, for a small engine made precisely to scale would not in itself be well proportioned; but this can hardly interfere with the lessons the model will teach us, and in order to impart to these articles as wide an interest as possible, I propose to give the proportions of certain specially important parts as they would be in larger working engines, together with the formulæ by which the proportions are worked out, so that my readers nay easily compare their models with the full-sized engines.

I shall commence with the most simple and easily constructed model which it is worth while to make, viz., that of a single-action oscillating cylinder engine; and I hope after describing those models which appear to come between this simple form and the more complicated and difficult half-horse power slide-valve engine, to describe this latter very fully so that my readers may find no difficulty (if they have followed me through the earlier articles) in supplying their workshops with steam power at a very small outlay.



FIGS. 1—6.—CHISELS. FIG. 7.—DRILL. FIGS. 8, 9.—SECTIONS OF D BIT. FIG. 10.—REAMER. FIG. 11.—SCREW PLATE. FIG. 12.—SCREWING STOCK WITH DIES. FIG. 13.—INSIDE TURNING TOOL.

The readers of AMATEUR WORK, who, in these days of cheap castings would prefer to make their own patterns, are, probably, few in number; and I shall therefore suppose the castings to be purchased from some one or other of the numerous firms which advertise these goods; and as amateurs often appear to find a difficulty (especially those living in the country), in deciding from whom to obtain such things, I have written to several founders, and am able to append the following particulars of the castings they supply. It must be remembered, however, that these particulars, except where otherwise stated, have been given me by the makers, and I cannot therefore guarantee their correctness further than by naming the sources from which I obtained the information. I subjoin the price asked by each maker for a certain size of engine, in order that my readers may have some idea of the various scales of charges.

Mr. R. A. Lee, of 76, *High Holborn*, supplies castings of all descriptions, from those for a single-action oscillating cylinder engine, at 2s. the set, to those for a Great Northern Express locomotive engine, at £7 10s. All the castings supplied by this maker, which require to be turned, are fitted with tenon pieces so that they may be easily held in a grip-chuck, for both turning and boring. Mr. Lee's catalogue, price 6d., will prove very useful to any of my readers who contemplate taking up the work in question. They will find that he charges for a set of horizontal slide-valve engine castings: Cylinder, 1 inch bore, 2 inch stroke, best quality, 6s.; common, 4s. 6d.; cylinder, 2 inch bore, 4 inch stroke, best quality, 27s.

Mr. D. Hughes, 17, *Smith Street*, *Kirkdale*, *Liverpool*, sends me his catalogue with some very neat working drawings and designs of horizontal slide-valve and launch engines, also of a neat little injector, the fitting up of which I hope to describe in the course of the present series of articles. The same maker also sent me a specimen of his gun metal castings; and if all the castings he supplies are equal in quality to this sample, I can safely recommend them to my readers. Mr. Hughes' catalogue gives following prices for castings of an engine: 1 inch bore, 2 inch stroke, in gun metal or brass, 4s.; and 3 inch bore, in iron, 27s. 6d.; and the working drawings for these two sizes cost 1s. and 4s., respectively. But he further writes me, "I would be happy to make up patterns and castings, either in gun metal or in brass, for any engine you may describe, at prices specially reduced for amateurs."

Mr. A. A. Dorrington, *West Gorton*, *Manchester*, has sent me his price list and some designs. He charges for castings of an engine 2 inch bore, 3½ inch stroke, 12s. 6d.; and 3 inch bore, 4 inch stroke, 28s.; working drawings, 2s. and 5s. respectively.

Mr. A. Wood, 15, *Dalley Street*, *Lower Broughton*, *Manchester*, supplies castings with tenon pieces to

those parts requiring turning, as follows: 1 inch bore, 2 inch stroke, 3s. 10d. per set; $1\frac{1}{4}$ inch bore, $2\frac{1}{2}$ inch stroke, 7s. 6d. Mr. Wood's prices for boring cylinders and such work appear to be exceptionally low.

Mr. J. Tomlin, 28, *Highfield Terrace, Barnsley*, supplies castings and forgings of half-horse power, horizontal and launch engines, cylinder $2\frac{1}{8}$ inch bore, $3\frac{1}{2}$ inch stroke, 12s. 6d. per set.

Mr. R. Thompson, 2, *Brookside Lane, Oswaldtwistle, Lancashire*, also sends drawings of half-horse power engines, $2\frac{1}{16}$ inch bore, and $3\frac{1}{4}$ inch stroke. He charges 12s. 6d. per set for castings, and 2s. 6d. extra for the forgings. He claims for his castings the superior advantage of having extra large steam and exhaust ports cast in the cylinders. Such parts as require to be turned are cast with tenon pieces affixed.

Now, with regard to the tools required in model engine-making, they are chiefly such as are found in the workshop of any amateur who has taken up metal-turning. It is sometimes stated that, provided the cylinder is bought ready bored, a lathe is not absolutely necessary. Perhapt not *absolutely*, but without it much additional time and patience will be demanded, and the results, both in appearance and working, will certainly be far less satisfactory. I would, therefore, by no means recommend anyone to undertake model engine-making, unless they are provided with a lathe.

A chuck for holding small drills, and a grip chuck holding from $\frac{1}{4}$ inch diameter upwards, will be found useful adjuncts to the lathe, and if the lathe is provided with a face-plate, so much the better.

A few small chisels of the shapes shown by Figs. 1 to 6 must be made from good square cast steel; these are for chipping out steam ports and similar work, and will not be required for the model I intend to describe first.

A few drills, from $\frac{1}{16}$ inch up to $\frac{1}{4}$ inch, of the ordinary shape, Fig. 7, will be required, and D-bits of the required sizes may be made as wanted. Fig. 8 is a section of a D-bit at its cutting end, and Fig. 9 is a section taken at a little distance down the shank.

A rhymer, Fig. 10, will be found useful. It is made from a piece of small steel rod, filed up to a triangular or five-sided shape, and tempered to straw colour.

A small steel square, usually known as an "engineer's square," must be included in the list of tools required.

Screws may be bought, but if they are to be made at home, as they easily may, the screw-plate, Fig. 11, will be necessary, and for the larger engines a screw-stock with dies and taps, Fig. 12.

The usual gravers, round-nosed and other turning tools, will be required, as also one or two inside tools of the form shown in Fig. 13; also, a few files, flat, half-round, and triangular, coarse, medium, and fine. A bench-vice is almost as indispensable as a lathe; and an Archimedean, or some other form of hand-drill for small drills, will often be found handy, in addition to the drill chuck already named.

One or two scrapers will also be found useful. These may be made from broken files, the teeth being ground out for a short distance from the broken end of the file, and the end then ground off straight across. These scrapers are to be used for giving the finishing touches to such work as cannot be got sufficiently level by filing.

A surfacing-plate may be placed among the tools it is very desirable to have, but it forms an expensive item, costing 12s. or 15s. and upwards, according to size; and small work, such as slide-valves, etc., may often be got up with sufficient accuracy by using the planed lathe bed as a testing surface.

Any other special tools required will be described as they are mentioned.

The castings selected should be even and free from holes, and should not present too rough a surface; also, all the parts should be of such size and weight that, when bored, turned or filed down as the case may be, they will still be thoroughly substantial both in appearance and in fact.

With these few preliminary hints I will leave this part of my subject; and in my next paper will proceed to consider the working up and fitting together of the castings.

DRY-PLATE PHOTOGRAPHY:

THE GELATINO-BROMIDE PROCESS.

By C. C. VEVERS.

I.—PREFATORY—HISTORICAL OUTLINE—WEDGEWOOD—BOULTON—NICEPHORE NIEPCE—DAGUERRE—FOX TALBOT—ARCHER AND THE COLLODION PROCESS—DRY PLATES.

I FEEL obliged to make a few prefatory remarks, but the reader may rest assured they shall be short and to the point. In this and the following papers I shall endeavour to describe one of—nay, *the* most beautiful and instructive of arts—pastime, amusement, if you like—that it has ever been man's lot to practise. I will not grow outrageously enthusiastical in my endeavour to explain this combination of science, art, and pleasure, but merely ask the reader to follow me, as it were, with camera in hand, through the lessons I am about to give him in photography; and when he has become

but an ordinary amateur, let him form an opinion of my demonstration of the art.

My instructions shall be as plain and simple as possible, but every branch of the art suitable for amateurs shall be fully dwelt upon and illustrated whenever practicable. I shall give only reliable formulæ—that which has been carefully tested and found best in practice ; in making mention of any piece of apparatus or chemical that is peculiar to the process, it shall be accompanied by the address of the manufacturer or dealer from whom it can be obtained the best and cheapest, and the price at which the article is supplied.

Designs to scale shall be given with replete instructions as to the making of any piece of apparatus I think is in the power of the average amateur to construct, and which I have first made and proved to be successful.

I must, before commencing the practical part of the process, give a brief outline of the history of photography, merely to give the tyro some idea as to the rise and progress of this wonderful art.

"Who invented photography?" This is a most difficult question to answer. Photography, like all other great inventions, or discoveries, cannot be said to be the production of one person alone.

It has gradually risen from the simple "camera obscura," invented by Baptista Porta, of Naples, as far back as 1556—to its present position. The invention has been attributed to many persons; Thomas Wedgewood—of pottery fame—about the beginning of the present century, managed to obtain an impression on paper coated with silver chloride, of an object placed in contact with it, and exposed to the sun's rays. This, however, was not what might be termed optical photography. Boyle is also said to have obtained similar "sun pictures" two hundred years ago. In latter days a new (supposed) inventor has been brought forward in the shape of Matthew Boulton, who was partner with the great inventor Watt. "Chambers' Journal" for September 3rd, 1864, contains a long article on this person, who is stated to have produced photographs both on plated copper and on paper. These pictures were said to have been taken in 1790 by the aid of *camera and lens*, which, according to the above journal, were discovered amongst a quantity of lumber in Matthew Boulton's library by a Mr. Price, an old retainer of the family of the Boultons, about the year 1840. The camera and lens, unfortunately, are stated to have been lost. This occurrence, I fear, explodes the whole story, as had there ever been found such a valuable relic it would have been guarded with more care.

Who first had an idea in the right direction I cannot positively say; the credit of the invention usually, and, I think, deservedly falls upon two men—Nicéphore Niépce and Daguerre. Nicéphore Niépce was a native of France, where he was born in 1765. He certainly had an inventive turn of mind ; amongst other things he, in conjunction with his brother Claude, introduced the bicycle or velocipede—in a very crude form, to be sure. Not until he was upwards of forty years old did he commence experiments in photography. About the year 1815, in letters to his brother (who was then in England) he described the production of pictures by the aid of light. Nothing remarkable occurred until 1826, when, through the medium of a French optician, he was introduced to Daguerre.

Daguerre, also of French birth, first saw the light in 1787. In 1824 he commenced experiments, and three years later he went into partnership with Niépce, with whom he worked until the death of the latter in 1833. The partnership was continued with Isidore, Nicéphore Niépce's son. In August, 1839, the process was first made public under the title *Daguerreotype*, the right to omit any mention of Joseph Nicéphore Niépce having been purchased from his son and Daguerre's partner—Isidore. The French Government, in return for thus making the process free for all, granted life pensions to the partners, Daguerre and Isidore Niépce. Its introduction caused a great sensation in the scientific and artistic world ; photography was to do away with the slow and tedious operation of painting ; artists were no longer required, and hundreds of people would therefore be ruined.

The process, however, was in a very primitive and imperfect condition. Daguerre discovered that if a piece of highly polished silver was held for some time over the fumes of iodide, a coating of iodide of silver was formed which was sensitive to light. For economy he used plated copper, the surface of which, after being polished was coated, as described, with iodide of silver, and exposed in the camera for *several hours;* a very faint and almost indiscernible image was produced on the film. Unfortunately Daguerre had no system of development, nor could he fix the impression. The plate with its picture could only be exhibited in the dark room by the aid of candlelight! This was a great drawback, but a lucky accident showed him a way of developing the latent image. Some plates, under exposed to such an extent that no picture was perceptible, were put on one side in a dark cupboard, where he also stored his chemicals. On returning some time afterwards to clean these plates he was astounded to find on each a picture perfect in every respect, more brilliant and full of detail than any he had ever obtained before.

He at once concluded that some of his chemicals were the cause of this wonderful change; he accordingly proceeded to test all the chemicals in the dark cupboard by giving short exposures to several plates, and afterwards placing them in the cupboard one at once, and at the same time removing a chemical. Each time a plate developed from an almost imperceptible image to a beautiful and brilliantly-defined picture. All the bottles were thus taken out of the cupboard, and still the plates after remaining a short time were removed fully developed. A more minute examination disclosed a small quantity of mercury which had been spilt in the interior of the cupboard.

It is needless to say that Daguerre, in future, always developed his plates. This he did by exposing the sensitive surface to the fumes of heated mercury. He also adopted the method of fixation discovered and used by Sir John Herschel—viz., hyposulphite of soda, the identical chemical used at the present day for the same purpose.

During the same year (1839) Fox Talbot, an Englishman, published in the *Philosophical Magazine* a process entirely different to that of Daguerre. The history of Fox Talbot's experiments is too long to detail fully here. I will, however, describe his process—called Talbotype, after its inventor—in its perfected state as concisely as possible. *Paper* of the finest texture was used. This he made sensitive to light by (1) brushing over the surface a solution of nitrate of silver—from 20 to 30 grains to the ounce of water. When dry the paper was (2) floated for three minutes on an iodide of potassium solution—25 grains to the ounce; it was then washed and again dried. The combination of these two chemicals formed a coating of iodide of silver of a cream tint on the paper. The following solution was then prepared: Saturated solution of Gallic acid, 1 oz.; silver nitrate, 300 grains; water, 6 ozs.; to this was added an equal quantity of acetic acid, which acted as a restrainer. This solution was then brushed over the paper — of course on the side before coated with a film of silver iodide. This sensitive paper required a much shorter exposure in the camera than did a Daguerreotype. After exposure the picture was developed by brushing over the paper the above solution, and afterwards fixed in a warm hyposulphite solution.

The resulting picture had the shades of nature reversed — that is, white objects were represented black on the paper, black objects white—or "negative," as it is called. In Daguerre's process, on the other hand, the shades were as represented in nature—or "positive," but everything was transposed; the right hand, for instance, appeared on the plate as the left. To overcome this difficulty Talbot made his paper transparent by melting white wax and immersing the paper in it; he could then obtain a large number of copies by "printing" through the negative on to a sensitive surface placed behind it, with the advantage of, at the same time, producing positive pictures. The method of printing will be described later, in an article devoted to that department. Curious to say, although Talbot's process has long gone out of date, paper, as a substratum for the sensitive salt, is again coming into use.

Great as were the improvements of Fox Talbot's process over that of Daguerre's, neither seemed to gain much favour with the public. Not until the invention of Archer, in 1851, of the wet collodion process, did photography, as a profession, assume a momentous aspect. Before this date amateur photographers were practically unknown. With Archer's process a few sprang up here and there, labouring under great difficulties; amongst these the amateur had to contend with the difficulty of obtaining chemicals sufficiently pure for his various solutions, those sold by the average pharmacopolist rarely being perfectly free from some impurity. In those days there were no photographic societies, no text-books to guide the rising amateur through his many, very many troubles. No wonder, then, the Amateur Photographer of 1851 did not flourish.

By Archer's process a glass plate is cleaned and polished, it is then coated with iodised collodion—composed of pyroxyline (gun-cotton), ether, iodide, and alcohol—and allowed to set, which it does in a few minutes. The plate thus collodionized is then immersed in a bath of silver nitrate, slightly acid. In this bath it remains until all greasiness (caused by the water of the bath dissolving the alcohol on the film) has disappeared from the surface of the plate, when it may be considered as sensitized. This will take place in three or four minutes; the plate will then have a milky white appearance. It is then placed in the dark slide, exposed in the camera, developed and fixed while still wet. By several modifications in the formulæ and a much shorter exposure, the picture will be shown *positive* by simply placing behind it some dark object—such as black paper

Although the collodion process requires an exposure ten or fifteen times as long as some modern gelatine plates, hundreds of professional photographers still prefer to work it. The resulting negatives, they say, are much more brilliant and clearer in the shadows than can be obtained with gelatine emulsion. Who has not, when strolling on the sands at a seaside watering-place, such as Scarboro' or Brighton, been requested by some gentleman who enticingly flashes before his victim's eyes a specimen of his handiwork, to "Have your likeness took, sir. Taken and

finished in two (?) minutes, by a new process, sir." This "new process" is the collodion positive above referred to, with which an enormous business is done at feasts, fairs, and other places of amusement to which the lower class resort.

For those readers of AMATEUR WORK who wish to try this process, I append a formula for wet collodion positives. Great care, however, must be used in handling the silver bath, as whatever the liquid touches will turn black in a few minutes on exposure to light; consequently, the operation of sensitizing should not be carried on in a carpeted room. It is also advisable the experimenter should wear an old coat and apron. Clean the glass and give a final polish with Tripoli, 1 oz.; iodine, 20 grains (1 scruple); methylated spirit, 6 liquid ounces. Coat with Mawson and Swan's positive collodion (1s. bottle), and sensitize (in the dark) in the following silver bath: nitrate of silver, 1 oz.; water, distilled, 12 ozs.; nitric acid, 1 drop. Develope by pouring the following solution on and off the plate until image appears distinctly—protosulphate of iron, 1½ oz.; nitrate of baryta, 1 oz.; water, 1 pint; alcohol, 1 oz.; nitric acid, 30 drops, and fix in cyanide of potassium, 1 dram; water, 3 ozs.

I cannot in these papers go further into the details of this process, but the amateur who wishes to study it will obtain sufficient instructions in "The Wet-Collodion Process," G. O. E. Wheeler (Bazaar Press, 170, *Strand*, *W.C.* Price 1s.) There is also the "Dry-Collodion Emulsion Process," but as this will not interest the amateur I shall pass it over.

About fifteen years ago the dry-plate process was introduced, and since that time photography, by the help of such men as W. B. Woodbury, Captain W. de W. Abney, Colonel Stuart Wortley, W. K. Burton, Jabez Hughs, Henry Baden Pritchard, Carey Lea, Dallmeyer, Dr. Eder, Dr. Vogel, Van Monckhoven, Warnerke, Valentine Blanchard, and J. W. Swan, has rapidly advanced to a high state of perfection.

Although the introduction of dry plates brought with it one or two disadvantages, the advantages derived from its use are innumerable, the two principal being that *years* may elapse, if necessary, between coating the plate with the emulsion film and development, whereas, with the wet collodion process the plates require to be developed and fixed within a few hours of sensitizing—in fact, before the film dries. Then, again, the plates are much more rapid, necessitating, on a very bright day, an instantaneous exposure.

With their introduction, dry plates became an article of commerce—the amateur, and indeed the professional, being enabled to obtain better plates at a cheaper rate than he could manufacture himself, and at the same time doing away with that great evil to the amateur's laboratory, hands and clothing: silver. Amateur photographers, who, twenty years ago were but rarely seen, are now counted by their *thousands*. Photographic societies were raised in almost every town, and the photographic dealer now sells every conceivable piece of apparatus designed for their convenience.

In the season, go where you will, to any public resort, there you will see the amateur with his camera: at the seaside, in the mountain and lake districts, in Switzerland and Norway, at galas, public processions, on the sea, on the road, on the train, and in the air.

The uses of photography, too, are incalculable. By Government it is used in war, in retaining the likeness of the criminal, and dynamite explosions; in copying forged notes, etc. To the artist, the engineer, the architect and builder, the lithographer, the illustrated press; to the doctor it is invaluable, and in almost every trade or profession it is used at some time. All the principal hospitals now have a photographer on the staff. This person photographs any special case, various stages of disease before and after operations, etc. An acquaintance of the writer, the resident surgeon at a large provincial infirmary, is an ardent amateur photographer. This gentleman photographs all his "lovely" cases, numbering and placing the prints in classes with a short account of each case, thus making, for his profession, a very valuable collection.

I shall, in my next article, describe the construction and fittings of the amateur's dark room.

(*To be continued.*)

PRACTICAL SCENE-PAINTING FOR AMATEURS.

By HENRY L. BENWELL.

XI.—TYPICAL SCENES—SNOW SCENE—SEASCAPE—METHOD OF GETTING DISTANCES BY THE AID OF SET PIECES.

IN order to assist the amateur in the production of suitable designs, I purpose in this, and the succeeding chapter, introducing a set of typical scenes. In doing so I select the most simple subjects, both as regards perspective and the general painting, but which will, nevertheless, look effective when transferred to the canvas. I may also add that they are adapted for a small or medium-sized stage, so I trust will be found generally useful. I am sorry to say that the engraver—*through no fault of his own*—has not, up to the present achieved very happy results

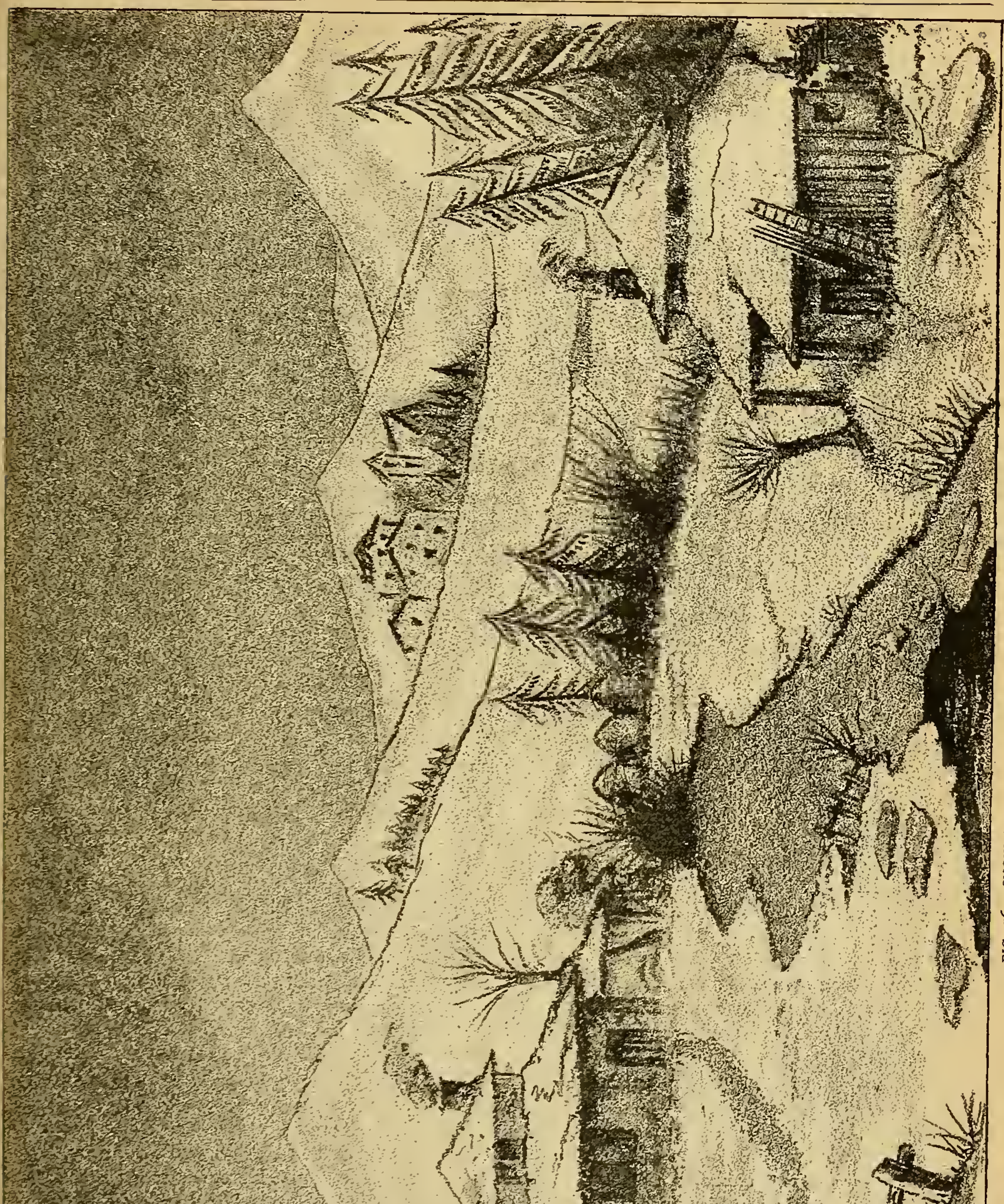


FIG. 56.—SNOW SCENE, EASILY PAINTED, BUT HIGHLY EFFECTIVE.

in reproducing the designs that accompany these papers, the sketchy and picturesque character of stage scenery being entirely absent. I am willing to admit, however, that the fault most likely lies on my own side, in sending drawings somewhat too finished in tone. In order to obviate this state of things, and obtain a more satisfactory result, I have, on the present occasion, as far as is possible with the camel-hair and ink, endeavoured to lay before my readers drawings of a seascape as it would appear when painted on the canvas in distemper, and also as it would or should look to those on the stage, *and not the audience*. It will, therefore, be seen that what I wish to lay before the reader is some idea of the scene itself, and not a reproduction of a pencil or water-colour sketch. In making these remarks I attach blame to no one but myself, and to the fact that the real art of scene-painting is so little known to artists generally, more so our clever engravers and lithographers.

How to Paint a Snow Scene.—In the illustration of the winter scene here given, I may say at once that it was one of my earliest attempts at the art, and the first that I painted professionally, hence I am prompted to give it here. A scene of this description is rapidly painted, as but few colours are required. The drawing also is easy, as perspective is conspicuous by its absence.

The drawing, Fig. 56, is taken from a small coloured rough sketch, made in about thirty minutes, to meet an urgent demand from an impatient manager, who required a snow scene for a play called, "The Orange Girl," or the "Frozen Tarn," which he intended playing on his benefit night. On looking through his scenery on the day of the performance, he discovered, much to his horror, that the stock snow scene had some time previously been painted out, *i.e.*, another scene, a cottage, had been painted over it. This is often the case in country theatres, where new canvas is not always to be had; in fact, scenes are painted one day, and painted out the next, frequently. However, I was called in, and asked to make a design at once; this I did in the time stated, and three hours afterwards the scene and side-wings were finished, and the irate manager satisfied with the work. I have often had to paint scenes at such short notice, but I mention this fact here to show that a snow scene, although it may look difficult, is really the easiest subject to paint, and is rendered effective by very simple means.

To colour the example, Fig. 56, the artist should use two shades of cold grey for the sky, adding a little more whiting to the lightest as he nears the horizon. Lay in the mountains and hills with flake white or whiting (the priming will do this), and add to the effect with faint washes of blue—this to avoid too much sameness. The cottages and trees in the distance are put in with the darkest sky colour, also the trees behind the cottage on the left, and the firs in the background on the right of sketch; mark up with a darker shade. The cottages are first of all laid in with any smudge colour; the doorways, woodwork, loose sticks and trees in foreground being painted with siennas, and shaded with vandyke brown. For the corn ricks use raw sienna and orange chrome, leaving the tops white and rugged as if covered with snow. The rails, etc., in the foreground are put in with raw sienna and brown, and when dry flake white may be added to give effect. The frozen pond receives a little ultramarine and whiting, varied in tint as shown in the "cut." In the foreground the ice is broken, and the water must be put in with sienna, indigo, and flake white. Footmarks, ruts, etc., may be painted a light grey. On the extreme right is a smithy or forge, flames and smoke are seen issuing from the chimney, and the reflection of the fire is cast through the half-open door on to the snow-covered ground without. The old ladder or other surrounding objects catch a slight share of this warmth, so that, by the judicious use of a little orange red, the picture may be considerably heightened. A little of this colour should also be rubbed in on the other cottage, but not as if coming as a reflected light from the forge. This is merely to enliven the scene a little. I have previously described the method of painting windows. The cracks in the ice should not be forgotten, nor the broken pieces of ice that are lying around. The foreground may be broken up with a little blue shading, put on somewhat darker than that given to the hills. The side-wings to match a snow scene are very easy to paint, and may be painted on the back of the ordinary tree-wings, and, in order that the rugged profile may be used, the right-wings must be used on the left of the stage, and *vice versa*. To paint them: give them a coating of grey priming, when dry, put in branches and trunks of distant trees, and brushwood with darker shade of bluish grey. Next, paint in the nearest trees with sienna, ochre, and vandyke brown, and finish by rugged patches of flake white on the upper side of branches, and between the forks of the trunks to represent snow. The bottom of the wing must also represent a snow-covered ground, and a mile-stone, rude palings, log of wood and other objects will greatly tend to make the picture more effective. The front wings must, of course, be painted more boldly than those at the back of the stage.

The snow scene in "The Orange Girl" is a most effective picture, the whole stage being supposed to represent a frozen pond, and two characters in the

piece actually fall through the ice with a crash, and are seen struggling beneath. This is a stage effect, which I hope to describe later on, when treating on the stage carpenter's art. I shall be happy to lend the coloured design to any one who thinks of producing a piece containing a snow and winter scene. I have also better, but more difficult, designs in my possession. To prevent any difficulty and unnecessary trouble, application must be made direct by letter to Mr. Henry L. Benwell. Letters must be sealed, stamped, partly addressed as requested, and sent under cover to the Editor of this Magazine, who will complete the address and forward the letters through the post to their destination.

Seascape and Marine Painting.—Scenes of this description are favourite subjects with many artists, as they give large scope for effect both for sky and water.

In marine painting the sky plays the most important part, so that the greatest care must be paid to this portion of the subject, as its expression always governs that of the water. If the artist intends to represent calm water, it is a good plan to have a large frame made, and covered with canvas, in the way I shall shortly describe.

For "rough sea," and when it is desirable to represent the waves in action, the "sea-cloth" must be resorted to. This is painted to represent the surface of the sea, with the waves and white foam. There is also a mechanical way of making the waves advance and recede; and all this I hope to explain when we come to the carpenter's department.

Seascape or marine views are, as a rule, merely painted on a "back-cloth," but I wish to describe a method which has much greater effect when set on the stage. On an ordinary "back-cloth" we put in, about half-way down an ordinary sky, or, if the painter prefer, with a sunset or sunrise effect, but what is better than any I give in Fig. 57?—namely, a somewhat troubled sky with plenty of clouds, but not in the present case as would suggest a storm, as the water is calm. The latter will tell out best against the water-set, Fig. 58, which I have just mentioned. This is merely painted on a frame as shown in the "cut."

We now have the "clouds" on the back-cloth, and the water on the set-piece, the latter made deep enough to stand on the stage. If the scene required be a "ship's deck," these two pieces will be the "backing" for the scene, and the wings I shall presently describe will be used for the sides. But, on the other hand, if we want a seascape pure and simple, and the stage to represent the foreshore, then the rockwork set-piece, Fig. 59, must be brought into use.

The scene is set in this way: the "cloth" with the sky is hung at the back of the stage; next comes the water set-piece standing about a foot from the cloth slanting slightly towards it, in order to take off the sharp edge. The rock-piece is set in the foreground about two feet from the water-set, but perfectly upright. The scene, when set on the stage, should appear as in the example, Fig. 60, which is an enlarged drawing of the scene in question, and which has been drawn in a special method, to give some idea to the reader of the broad and bold treatment so necessary in scenes of this description. I trust the attempt has proved successful. This scene is, practically, a simple form of set-scene as just described, but the subject may, if preferred, be wholly painted on the back-cloth, or the sky and sea both may be painted thereon, and rock-piece used as before.

Again, by using the water-set of sufficient height you may use a "landscape cloth," providing all is hidden except the sky, and thus save painting the latter part of scene. I should add that ground-lights should be used behind both "set-pieces" to kill the shadows thrown from the footlights.

As regards the painting of a scene after the design, Fig. 60, I do not think I need say much as to actual colouring, after the advice given in the last chapter, and more so as I shall later give a full table of tints.

Perhaps I may say a word about the rocks and loose stones in the foreground. These, in a professional painting, would often be put in with "smudge colours," *i.e.*, odds and ends and palette scrapings all mixed together in one pot, and known as the waste pot. Of course rockwork may be painted in various ways according to taste. Some of the following tints will, however, be found generally useful: Indigo, burnt sienna and rose pink; vandyke brown and ultramarine; indigo, rose pink and ochre; yellow ochre and Venetian red; lake; ultramarine and orange red; yellow ochre, umber, and indigo.

Side Wings for Marine Views.—As I shall next give instructions for the painting and arrangement of a scene representing a ship's deck, I here draw attention to horizon wings. These are merely side-wings painted to represent sea and sky. In painting these care must be taken to make the horizon line on the wings the same height as it is on the *cloth*, and also to make the water blend in with the same subject. These wings are so simple to paint that I do not think an illustration necessary, but they will be seen accompanying the "full set" of the ship's deck given in the next chapter.

If a stock of horizon wings are kept on hand, care must be taken not to misuse them. A set of these I have frequently seen made use of when a *practicable*

FIG. 57.—BACK CLOTH, SHOWING TROUBLED SKY WITH CLOUDS.

FIG. 58.—WATER SET, FOR SEASCAPE, SHOWING SEA, AND ISLAND IN DISTANCE.

boat is used in the scene. There is the river or sea depicted on the back cloth, and a few feet lower down the stage, *i.e.*, towards the audience, is a *ground row;* between which and the back cloth the boat is worked. The actors step out of the boat, over the ground row, and—if the horizon wings are used, which only represent sea and sky—into the water. This, of course, is most ridiculous, and should be carefully avoided by the Stage Manager or Scenic Artist, whichever may be in command. Sufficient attention is not given as a rule to these scenes, and managers should bear in mind that horizon wings are not required in all water scenes, but

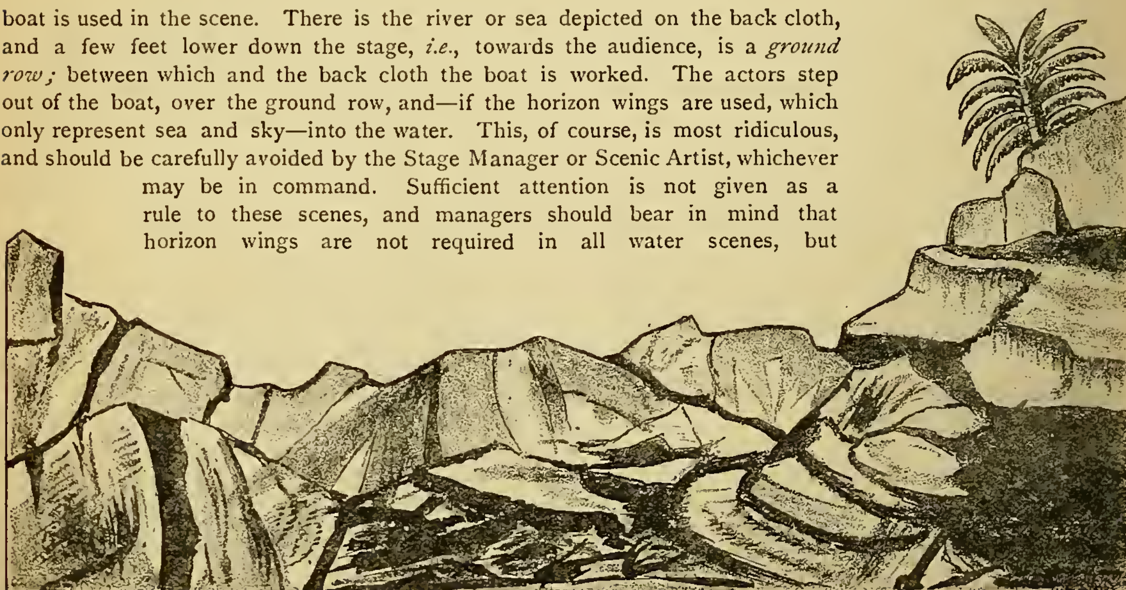


FIG. 59.—ROCK WORK SET PIECE FOR FOREGROUND OF SEASCAPE.

FIG. 60.—SEASCAPE, EXHIBITING METHOD OF GETTING DISTANCES BY AID OF SET PIECES.

are, on the contrary, very seldom requisite. Proper wings should be used for every scene set on the stage, as it adds so much to the effect of the picture. In painting both seascape, sea wings, and shipping, care must be taken to indicate, in every detail, the weather suggested by the words (if any) that fall from the actor's mouth. It would not do for him to be raving about on a ship's deck in the midst of a supposed storm, if the picture on the "cloth" and wings represented a dead calm. Again, if the latter is suggested, a ship's sails must not be set full ; but if the water is painted rough and lumpy, they must of necessity be painted full. I shall have more to say on this subject in a future chapter.

(*To be continued.*)

SMITHING AND FORGING.

By GEORGE EDWINSON.

II.—SOME BLACKSMITH'S TOOLS—ANVIL, VICE, DRILLING APPARATUS, SLICE AND RAKE.

THERE was a time in the history of the blacksmith's art, when a stone, or probably a meteorite, held in a twisted stick, or bound to a handle of wood by thongs, formed the smith's hammer, whilst a large stone was utilized as his anvil. Then came the time in the evolution of his art, when a piece of iron bound to a stick formed the hammer ; this in turn gave place to a piece of iron bent to form an eye for the handle ; and this became improved in form until some enterprising son of Vulcan conceived the idea of employing steel welded to iron to form the hammer, and then the modern steel-faced hammer was created. Having learnt how to make a hammer by welding pieces of iron together, the anvil became the next subject for improvement, and some few hundred, or or perhaps, thousand years ago, it was possibly a general practice for smiths, not only to make their own hammer, but also their own anvils. That time, has, however, passed away, and the event would be rare where a smith attempted the manufacture of his own anvil, vice, or swage-block. Those necessary tools are now made for him by professional tool makers, and are sold to their customers at so much per cwt.

The Anvil.—So much has already been written and published in AMATEUR WORK concerning a blacksmith's anvil, as to leave little or nothing for me to say about this useful tool here. A fully illustrated description of a simple anvil, mounted on its block, may be found in the sixth artiele on "Brazing and Soldering," Vol. II., p. 580. Two more illustrations of anvils will be found in the first article on "A Few Hints on the Use of a Forge," by Mulciber, Vol. III., p. 404. As, however, a few new subscribers may wish to avoid reference to back parts, I herewith give a sketch and description of another form. The anvil shown in p. 586, Vol. II., had only one square hole in the tail to hold the tangs of swages, chisels, and hot setts ; the same may be said of both shown in p. 404, Vol. III. This anvil (Fig. 11), as will be seen, is furnished with two additional holes near the beak, one of these being round, the other square, both used as bolsters to pieces of hot iron, whilst holes are being punched through them. The weight of anvils vary from ½ cwt. up to 5 cwt., according to their destined use. For real work, an anvil should not be less than 2 cwt., and the cost of such a tool will be about £3. Anvils of less pretensions can be purchased at a lower rate from dealers in second-hand tools.

The anvil-block is simply a rough block of wood, such as the stump of a large tree, embedded in the floor of the smithy, near the forge. This block must be sawn level at the top, and of such a height as to bring the surface of the anvil level with the thigh of the smith. Some persons prefer a lower, some a taller anvil ; but the above may be taken as a guide to the requisite height for comfortable working. The point, or beak of the anvil, is usually set to the left of the smith, but some persons prefer it pointing to the right, this arrangement being probably to suit a left-handed workman. The position of the anvil is shown on the plan previously given—that is, it should be about 2 feet from the side of the forge, and the same distance from the *tuyère.*

The Vice.—The next important fixture in a smithy, is that of a vice and vice bench. The bench itself should be built with planks supported by stout quartering, and firmly fixed to the wall of the smithy beneath the window, in such a manner as to place the vice with the light from the window full on the work held in its jaws. At the back of the bench, against the wall, immediately below the window sill, should be fixed a narrow strip of wood, and to this should be nailed a strip of hoop-iron (Fig. 25) gathered up into loops of various sizes to suit the dimensions of the tools which will be placed in them. Nearly all the tools used at the vice may be placed in those loops, and, when kept there, will be found ready to hand when wanted. Respecting the vice itself, much might be written, for the tool exists in many varieties, the most common being that shown at Fig. 14. This form may be had in various sizes, and at almost all prices, from a few shillings up to several pounds. It is fixed to the bench by a few stout screws at the top, and the foot of its leg is held in socket fixed in a post at the bottom. The jaws of this vice do not open parallel to each other, but expose a gap more and

more wedge shape as the jaws are opened. The screw also gets clogged with filings and dust, and thus necessitates frequent cleaning. These inconveniences are done away with in the new parallel jaw form of vice now in the market, and I heartily recommend my readers to buy one of the new vices, instead of the old form of vice above described.

In the new forms of vice, the jaw nearest the workman is fixed to the frame of the vice, and the other jaw slides along on the box in which the screw works, away from the workman. The screw is thus protected from all dust and dirt, the jaws move parallel to each other, and present a parallel gap to all dimensions of work ; the work is held over the bench, and long bars may be supported on it whilst being tightened in the vice, the workman can also stand up close to the bench whilst at work. Such vices are sold, from 10s. 6d. for a 3-inch vice, up to higher prices for larger ones, by Mr. A. S. Lunt, 297, *Hackney Road*, *London*. A descriptive illustrated notice of his "Handy Parallel Vice" was given in "Notes on Novelties," p. 141, Vol. III. In choosing a second-hand vice, examine well the jaws, and see that they are not battered and broken, also, test them with a file for hardness, and note the condition of the teeth ; then examine the thread of the screw, and avoid altogether a half-worn tool.

Boring and Screwing Gear.—A smithy, to be properly fitted up, must have some kind of boring and screwing gear. The most primitive gear extant is that of the fiddle bow and drill, whilst the most finished is that of the automatic boring machines used in large workshops. The most common boring apparatus found in country smithies, is made up of the stout brace, shown at Fig. 13, and a set of stout drills to match. Best drilling braces are made with the adjusting screw shown in the sketch, and can thus be easily made to take up the cut of the drill as required. Others are worked under a steel-faced bracket, marked with dots for the point of the top part of the brace fixed above the vice bench. When an adjusting screw has not been provided, the overhanging bracket takes the form of a weighted lever, hinged to the upper frame of the window, and this is made to press on the brace, as shown in Fig. 14. Both forms have their separate advantages. That shown at Fig. 13 can be readily adjusted to any drill or to any work, and the brace can be moved to any part of the bench within the radius of the projecting arm, but the pressure on the drill must be maintained by frequently moving the adjusting screw above. In using this form over a bench, away from the vice, the work should rest on an iron plate perforated with holes, varying in size with the sizes of the drills, or be supported on a piece of wood placed on the bench. Illustrated instructions on how to make such an apparatus cheaply, were given by Mr. James Lukin, in p. 549, Vol. II., and a similar vertical drill apparatus for amateurs, has been recently described by Mr. F. J. Durrance in p. 49, Vol. IV. The lever pressure vertical drill shown at Fig. 14 can be easily and cheaply erected by the amateur smith. The sketch so clearly shows its construction as to render minute description unnecessary. It may be fixed over a vice, as shown, or over an iron bed plate, or any other part of the bench. The weighted lever can be made to apply any required pressure on the drill, and can be readily eased by a light pull on the cord, suspended from the smaller lever. In a future part of this series, instructions will be given on making braces, drills, and other parts of boring and drilling gear ; at the same time, I may also give directions for the home manufacture of screwing tackle, such as stocks, dies, and taps, but for the present I advise the purchase of such necessarily exact tools.

Slice and Rake.—I will now suppose that the workshop has been built, and fitted with forge, bellows, anvil, and vice bench. A light hammer of some kind has been procured, a small stock of iron has been bought, and a few bushels of slack, or small coal, has been placed in the coal hole. We will therefore light up the fire, and try our 'prentice hand at making the necessary forge tools, of which the slice and rake are the most simple. The slice, Fig. 15, would be named by the uninitiated, a fire shovel, but we must not thus betray our ignorance of the technical terms used in a smithy. The rake, Fig. 16, might be dubbed a poker, and as this is the most simple tool, we will deal with that first. Pile up several shovels full of slack around the *tuyère* (or tue-iron of the forge), get a few cinders, and a handful of shavings, scoop a shallow pit in the slack in front of the *tuyère*, put in the shavings, heap up a few cinders on top, apply a light, and proceed to blow gently. Now draw in a little of the slack among the hot cinders, and continue to blow until the whole mass begins to glow, then damp the slack on the outside of the heap, and by this means circumscribe the fire within an area of 6 inches from the *tuyère*. Blow on until this area has been filled with fire, then allow it to rest whilst we cut off a piece of iron for the rake.

Cut off with a cold chisel a piece of $\frac{3}{8}$ iron rod, 36 inches in length. Heat one end of it until about 2 inches becomes glowing white hot, and appears to be soft and pasty in the fire. Draw it quickly out of the fire with the left hand, lay the heated end on the outer edge of the anvil, and proceed to hammer the heated iron, whilst the left hand is employed in giving the rod a one-quarter turn after each blow. Strike the iron lightly on the tip of the rod, and gradually withdraw it as it is being

turned and hammered, bearing in mind that you are aiming at drawing out the heated end of the rod to a point, having a square section. Strike the iron only whilst glowing hot, and return it to the fire when it has cooled to a dull red. The motion of one-quarter turn only will not be attained at the first trial, nor until the left hand has been trained to work in unison with the right; so that the first point drawn will be most irregular in shape, but practice alone can get the hands into training, and the novice must try to put a good face on a few inches of spoiled iron. If he should hammer the iron after it gets too cool, he will assuredly split the point and spoil the iron, it is therefore best to err on the side of too many heats, until he has acquired sufficient skill to draw out a point in one heat. If he has succeeded in squaring down a point at the first heat, let the next be employed in rounding the corners, and this must be done lightly and quickly whilst the iron is glowing hot, aiming at drawing it out to a flat tapering point, as shown at Fig. 17. Return the point to the fire, heat it to a dull red, and bend it over the outer edge of the anvil with a few light blows to form the crook, shown in Fig. 16. The looped end of the rake may be simply heated to a dull red, and bent over the anvil back to the proper form, or it may be welded together at the junction of the shaft with the loop. To do the latter, it will be necessary to first scarf the extreme end of the iron, that is, thin it down whilst hot before bending the loop.

I will, however, suppose that the amateur smith wishes to do this first job in the easiest manner; and as it is just possible he may burn his iron and spoil it whilst welding the scarfed end to the shoulder of the loop, I will avoid that casualty by directing that the loop be made by simply bending the iron to form a loop. First then, heat a part of the iron, about ten inches from the end to redness, bend this over the edge of the anvil to the form shown, Fig. 18. Return to the fire, heat 3 inches more of the bent part, and shape it as shown at Fig. 19. Again heat up, and finally bring the end around to touch the shoulder of the loop, Fig. 20, and shape the loop whilst hot by a few light blows until the perfect form has been attained, as shown at Fig. 16.

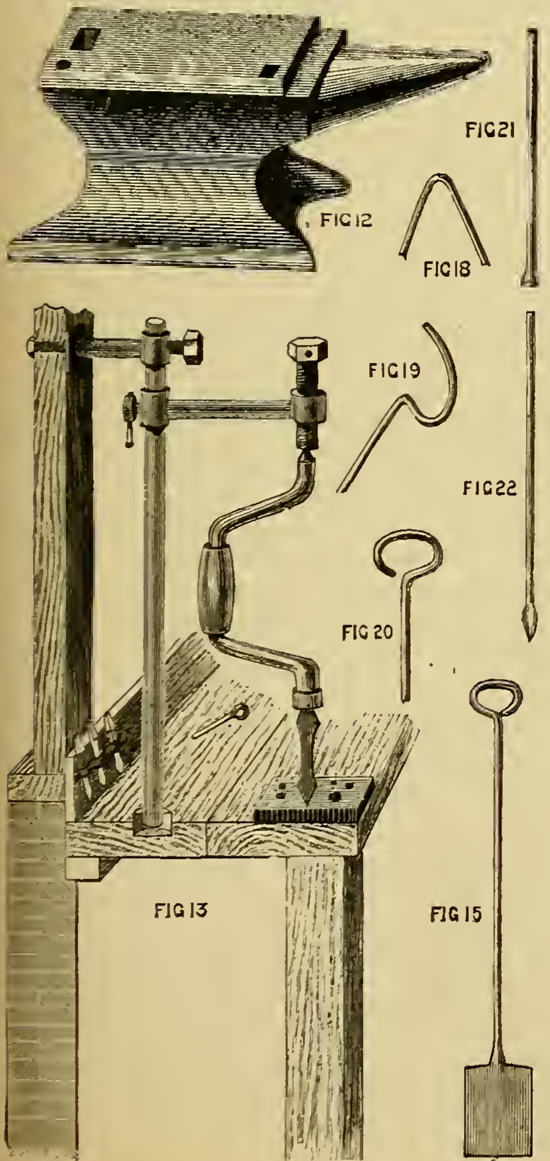
The operation of making the loop, or eye, should have been mentioned first, because it is usually first in practice, and is an easier job than that of making the hook. Therefore, in proceeding to make the "slice," it will be best to begin by making the eye first on a piece of $\frac{3}{8}$ inch iron of the same length as that employed for the rake. Next heat the other end of the iron, and upset it. That is, heat the extreme end of the iron until it is white hot, and begins to spit sparks, then quickly withdraw it, and bump the end on the anvil's face with the rod vertically above it, then catch up the hammer and proceed to knock up the heated end until it assumes the form of Fig. 20. Return it to the fire again, heat it white hot, then proceed to scarf the upsetted end; that is, form it into a flat point of irregular outline as shown, Fig. 22. Next cut off a piece of sheet iron or flat iron, 5 inches by 3 inches by $\frac{1}{4}$ inch, and cut out a tang 1 inch in length at one end as shown, Fig. 23. This tang must now be heated, upset, and scarfed, as in Fig. 24, to correspond with the end of the iron rod just prepared, and for this purpose we shall require a pair of light tongs to hold the hot iron. When this has been done, heat the two scarfed ends in the fire until they both glow white and emit sparks, move them occasionally, and watch them to see that one does not get hot faster than the other, for iron begins to burn when it sends out fizzing sparks; get both pieces of equal heat together, if possible, then prepare for welding. Place the hammer on the anvil block handy to be taken up quickly, grasp the tongs in the right hand, and with it withdraw the slice from the fire at the same time as the left hand withdraws the rod; step back to the right-hand end of the anvil, lay the slice with its scarfed tang on the extreme outer edge of the anvil, press the rod with the left hand on the opposite edge, bring the scarfed end of the rod 1 inch over the scarfed end of the slice, press it down hard with the left hand to hold it there, drop the tongs, quickly take up the hammer, give the glowing, fizzing joint a few light but smart taps, and then return it to the fire.

Heat up the joint again to a welding heat, then withdraw it; place it on the outer edge of the anvil, and proceed to lightly hammer it all round, the first object being to close the scarfs thoroughly; then whilst the iron is plastic, to round the weld as nearly as possible to the contour of the unheated part of the rod. To do this last, the blows must be light, and the rod kept "well alive" with the left hand. If the scarf is made too long, that is, longer than I have directed, a clumsy and imperfect weld will be the result, showing distinctly the seam of the scarf; and on the other hand, if the iron is overheated, that is, burnt, or heated too many times to a white heat, the joint will be thin and irregular.

The operations of making the rake and slice should have taught us something about the nature and behaviour of iron when heated to a "bending heat," that is, *red hot;* when heated to a "drawing-down heat," that is, *white hot;* and when heated to a "welding heat," that is, *a glowing white heat emitting sparks.* As this last is the heat at which iron burns away, we must not allow it to continue at this heat one moment longer than necessary, for each moment

lost means waste of iron, and worse than this, the conversion of good iron into bad by a destruction of its proper portion of carbon.

We shall also have learnt how to bend iron on the back of the anvil, how to draw out iron to a point on its outer edge, and how to weld together two pieces of iron. The novice must not only bear in mind the old adage to "Strike the iron whilst it is hot," but also be determined to try, try, try again, if he fails at first. He may have to cut off burnt iron and begin again afresh. He may even spoil several lengths of iron until he gets his hands and eyes educated to smith's work; but all the while he is



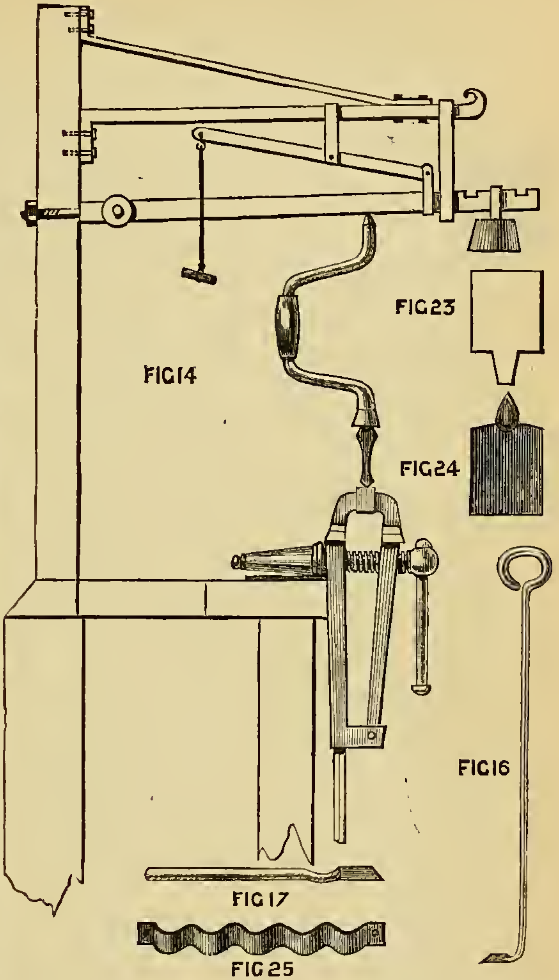


FIG. 12.—ANVIL. FIG. 13.—VERTICAL DRILLING BRACE AND POST. FIG. 14.—VICE, DRILLING BRACE, AND LEVER APPARATUS FOR DRILLING. FIG. 15.—SLICE. FIG. 16.—RAKE. FIG. 17.—IRON ROD DRAWN TO FLAT POINT. FIG. 18.—FIRST BEND OF IRON OVER BACK OF ANVIL. FIG. 19.—SECOND BEND. FIG. 20.—THIRD BEND TO FORM LOOP OF SLICE. FIG. 21.—IRON ROD UPSET. FIG. 22.—IRON ROD, SCARFED. FIG. 23.—BLADE OF SLICE. FIG. 24.—BLADE OF SLICE WITH TONGUE SCARFED. FIG. 25.—HOOP IRON WRINKLED TO FORM LOOPS FOR RECEPTION OF DRILLS, ETC.

learning, and must expect to have to pay a little more for his lessons than the mere cost of buying AMATEUR WORK.

This lesson will be enough for the present. In my next I hope to give instructions on how to make tongs, setts, swages, drills, punches, chisels, and other blacksmith's tools, that the amateur smith will require, and which he may as well learn how to make for himself, as in case of some pressing emergency it might be absolutely necessary for him to do so.

(*To be continued.*)

THE REFLECTING TELESCOPE:

ITS CONSTRUCTION AND MANUFACTURE.

By EDWARD A. FRANCIS.

V.—METHODS OF WORKING (*continued*)—BY MACHINE.

AS has been stated in a previous paper, the earliest specula were ground and polished by hand. No record of the use of a machine for that purpose can be found, until the time of the elder Herschel. The predecessors of the reflecting telescope—those aërial telescopes, which, with an aperture of only 3 inches or so, had a focal length sometimes no less than 300 feet—were indeed often constructed with machine-worked lenses; but the early speculum workers seem to have had a wholesome dread of trusting to a "senseless machine" that delicate figuring, which, to perform successfully with the unaided hand, required such vast experience. This was all very well while one man was powerful enough to do the work, and small specula only were being ground; but when it was required to employ workmen day and night, in gangs of twelve, to relieve each other in the polishing of a large speculum (and Sir William Herschel had to do this), there is little cause for wonder in the fact, that that indomitable workman began to exercise his great mechanical abilities, in the planning and construction of a speculum-grinding machine: which goes to prove my former statement, that the adaptation of machinery to speculum polishing was necessitated by the attempts to construct giant reflectors.

According to the statement of his admirable sister, Caroline, Herschel succeeded in making a machine fit for use, about the end of the year 1788. Were this information wanting, as much could have been gathered from another source; for, three years later, William himself records an observation of the planet Saturn with "a new machine-made most excellent speculum." Yet in 1857, a writer (Dr. Robinson) complains that the apparatus in question had never been described, and suggests that a great boon would be conferred on the scientific world if the Herschels would publish the manner in which their excellent specula were formed.

On the 22nd day of August, 1822, died Sir William Herschel. So that he appears to have imitated his predecessor, James Short, in the secrecy with which he surrounded his method of speculum working; and we hear no more on the subject until the inventor's son, writing for the "Encyclopædia Britannica," gave therein a description of the machine and the manner in which it was used. To that authority, accessible to all of my readers within reach of a public library, I refer those who may be curious to examine the details of the first speculum-grinding machine—a machine in which the speculum was worked over the tool and polisher, and the movements of the hand imitated by ingenious but simple mechanism. For the action of a speculum-working machine, be it remembered, is in every respect an imitation of the action of the hand in hand polishing, the movement of the rods and cranks of the machine representing the movement of the workman's arms: only the human mechanism permits of far greater adaptability to circumstances than the cranks of a machine.

While the "great astronomer" was secretly perfecting his invention, other brains and hands had been at work. Lord Rosse (then Lord Oxmantown) in 1828, and again twelve years later, published a description and drawing of a machine (to be hereafter described in this paper), with which he had successfully worked specula up to three feet in diameter, and by the aid of which he finally completed the speculum (which weighed three tons, and for dimensions yet remains unrivalled) of his great six-foot reflecting telescope.

Before the end of March, 1834, Dr. Richard Green had also invented a machine, upon which specula of excellent quality up to nine inches in diameter had been worked, and for which he subsequently received the gold medal of the Society for the Encouragement of Arts. A full description of this machine, with plate, will be found in the "Transactions" of that Society, Part I., vol. 50. In this case also the speculum was worked over the polisher, and it is noticeable that the wheels, with the exception of that forming the revolving table to support the tool, were vertically placed.

By this time Lord Rosse's machine had become known, and Mr. William Lassell, an amateur optician, failing to obtain good results with it, drew up an entirely different and original plan. This plan he handed to his friend, Mr. James Nasmyth the engineer, who, on it constructed a machine, complicated indeed, but nevertheless one, which, when certain additions suggested by experience were made to it, was long considered the most perfect of its kind. It would require a skilled engineer for its construction so that I have not considered it necessary to illustrate it here; but must again refer those of my readers who may be specially interested, to a description of it, which appears in the article "Telescope," in the eighth edition of the Encyclopædia before mentioned. Another machine of simpler construction has since been planned by the same amateur, specially designed for the working of large specula.*

Passing over a first machine constructed by Mr. Grubb, of Dublin (a professional optician), the next and last one to which the reader's attention should be

* See Part I. of the "Transactions of the Royal Society of London" for the year 1875.

drawn, is the second machine formed by that gentleman for the purpose of working the specula of the great Melbourne Cassegrainian Reflector. It is of the simplest construction, and apparently any desired form of stroke can be obtained from it.*

Were any apology necessary for introducing this subject at length, I would direct the attention of the reader to the fact, that with the exception of that of Mr. Grubb, all the machines of which I can find a record, have been the outcome of purely amateur research. A wide field is thus opened for those who, in addition to an intention to construct a telescope, possess constructive engineering abilities and tastes. A few other machines have been described in English periodicals during later years, but have in most cases been, as Dr. Greene would have said, "the offspring of a heated imagination, too generally failing shortly after their premature birth when subjected to the severe test of practical application."

My preliminary discourse is ended, and now the description of two typical machines, shall form the text for a full investigation into the kinds of stroke; the necessity for a sound understanding of which is shown in the last paragraph but one concluding the second paper on this subject (page 52), which paragraph must be considered as part of the present article.

The reader should by this time have provided himself with the two glass discs necessary for the tool and speculum. Let him bring them forth : he will then be able to demonstrate from my description the different kinds of stroke, with much benefit to himself when the actual working begins. For although this paper is entitled and nominally treats of working by machinery, that title is merely being used as a foil, which shall show up with greater distinctness the use and effect of the movements necessary in hand-working.

To secure equality in the abrading action, either when hand or machine-working, it is indispensable that the tool or polisher and the speculum should be and remain in a horizontal position while action is proceeding. It would be useless, for example, to attempt to work a speculum if it was rotating vertically in the lathe, as the writer lately discovered an amateur astronomer, who possessed considerable theoretical knowledge of optics, preparing to do. Small lenses are occasionally so worked, but it is impossible to truly form any spherical surface of moderate dimension in that position.

Place the glass discs, one upon the other, on a table or bench (as in Fig. 16, page 57)—the lower one fixed, perhaps, sufficiently by its own weight. The upper disc should be lying centrally over the lower, the worker remaining in one fixed position (A, Fig. 1) with respect to the bench. The open hands should rest upon the back of the upper disc, as in the sketch accompanying the third paper, so as to secure control over any movement it may be desirable to give to it. Let the worker now push the upper disc in a direct line from him, until its centre is almost on that edge of the lower most distant from him, and the discs are in the relative positions shown in Fig. 17, page 57. Then, reversing the direction, pull it back past its original position until its centre is again on the edge of the lower disc, but this time near to the worker, A. The centre of the upper will then have moved in a line over the lower glass, very similar to that shown by the solid line in Fig. 26, marking out part of a very irregular elongated ellipse. This motion we will term for further reference *straight stroke*, for the reason that it is simply reciprocal motion in a series of almost straight lines. Such a movement could be obtained in a machine by a crank motion, as in the mechanism of the driving-wheel of a locomotive.

But if the upper disc in the process of grinding were simply moved to and fro in the direction indicated by the solid line, the resultant concavity in it would be irregular, owing to the excess of action on the line A B over that near the edges *a b*. In order to equalise this action, the stroke should be given in an ever-varying direction, as indicated by the dotted lines. To insure this, either the workman at A should move around the bench, giving each stroke of the upper disc across the lower from a different point in the circumference to that of the preceding one, or the lower disc should revolve, and by presenting a different diameter of its surface to each direct stroke produce the same effect.

When hand-working, the former method is followed ; in machines the latter

To cause the lower disc to revolve in a machine, it merely requires to be supported upon a horizontal wheel. So that we have already two essentials for a straight stroke machine—to wit, a crank motion to give the stroke, and a revolving table to carry the lower disc. To these movements two others are added. Referring to the first figure, it will be seen that the lines all meet at the centre of the disc. In the rough grinding with plain tools this causes excess of action at that point, by reason of the abrading material collecting there ; and when working with a faceted tool, or polishing with a faceted polisher,

* The late Prof. Henry Draper, of New York, in 1857, and subsequent years, produced several machines specially adapted for the working of glass specula, some of which are illustrated and described in "Smithsonian Contributions to Knowledge," Part 180 (Washington, 1864). Space will not permit me to describe or illustrate them here ; but those of my readers who intend to pursue the art of speculum working by machine would do well to obtain that publication, if possible, through some foreign bookseller.

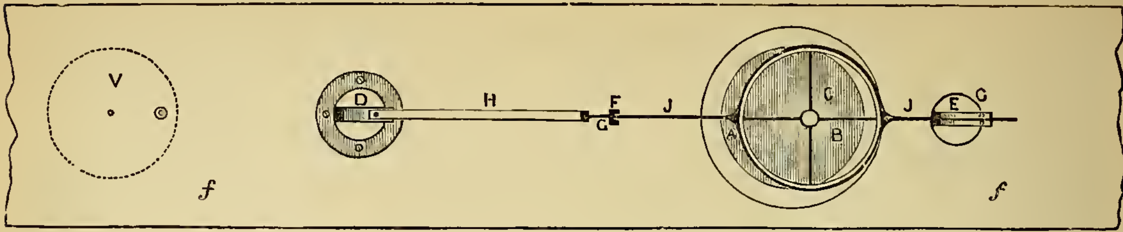


FIG. 28.—LORD ROSSE'S STRAIGHT-STROKE MACHINE—PLAN.

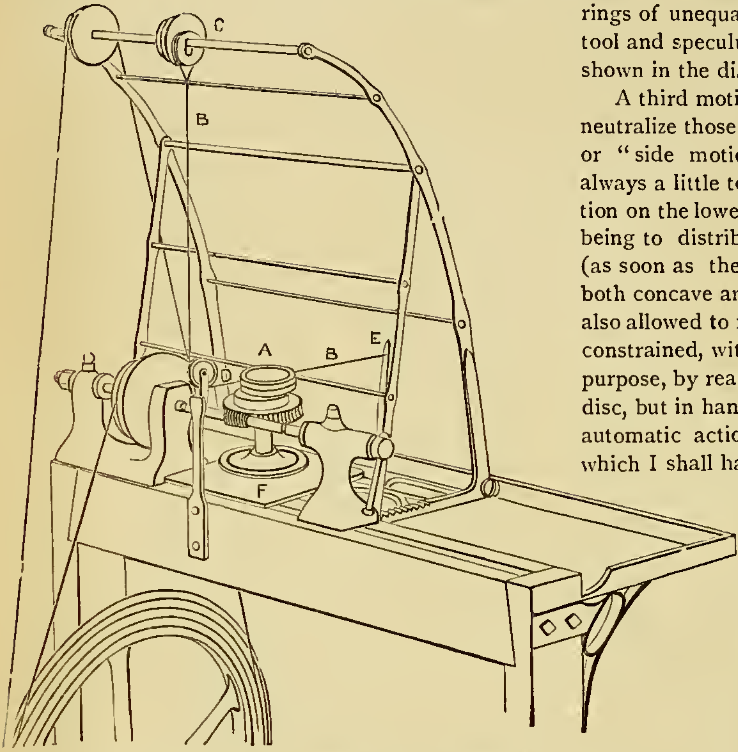


FIG. 30—REV. W. HODGSON'S SPECULUM GRINDING MACHINE FOR SMALL SPECULA, ADAPTED TO A LATHE HAVING OVERHEAD MOTION.

rings of unequal wear are caused if the centres of the tool and speculum coincide at every stroke, as I have shown in the diagram.

A third motion has therefore to be introduced to neutralize those errors. This third motion is a lateral or "side motion," causing the upper disc to pass always a little to the right or left of its preceding position on the lower. The object of the speculum grinder being to distribute the action as evenly as possible (as soon as the roughing-out is accomplished) over both concave and convex surfaces, the upper disc is also allowed to revolve. In a machine it does this, if unconstrained, without any special adjustment for the purpose, by reason of its stickage to the lower rotating disc, but in hand-working, it is obtained by a certain automatic action of the muscles of the hands, of which I shall have more to say later on.

In Fig. 27 is illustrated, slightly modified, and in section, Lord Rosse's straight-stroke machine, of which Fig. 28 is a plan, drawn simply to show the manner in which the rod J J is rigidly connected with the ring, embracing

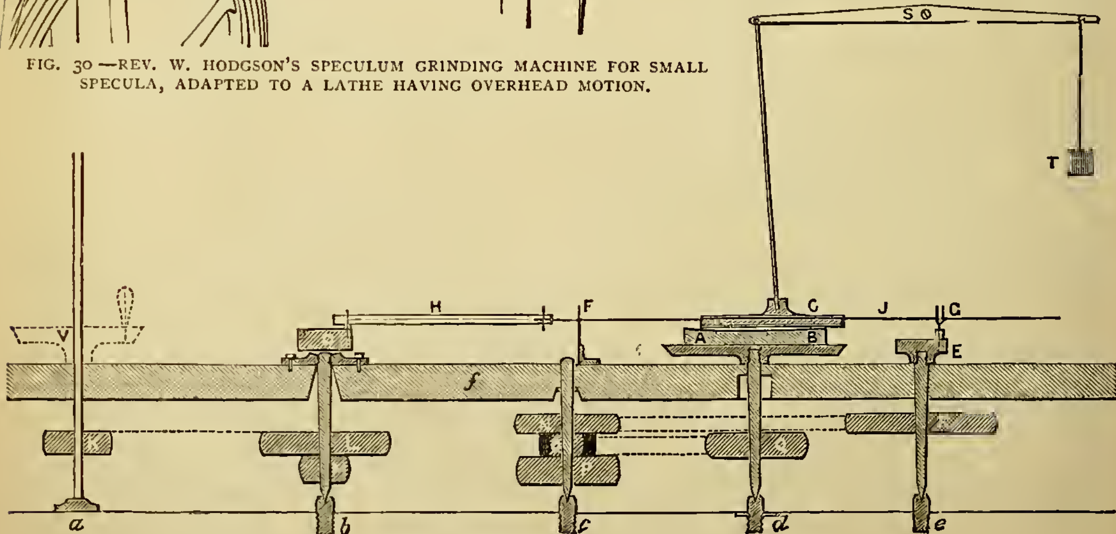


FIG. 27.—LORD ROSSE'S STRAIGHT-STROKE MACHINE—SECTION.

the polisher C. A table, *ffff*, is vertically pierced by five spindles, *a*, *b*, *c*, *d*, and *e*, with their pulleys. The speculum A B is resting face uppermost upon its revolving table. My readers should clearly understand, that the effect produced is the same when the speculum is being worked face downwards over the tool (as by hand) and the *tool* revolves, as when the tool is being worked over the speculum (as in this machine), and the *speculum* revolves. The first movement requisite is most evidently a straight stroke. This is obtained by the adjustable eccentric D, and the jointed crank H J J, which is caused

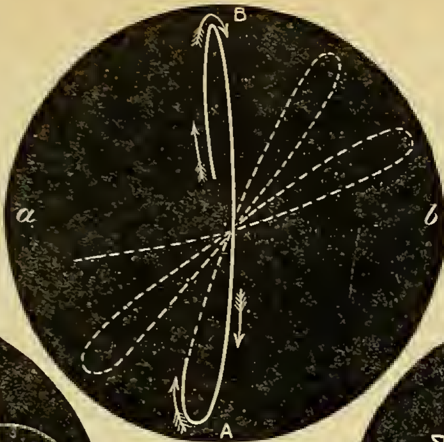


FIG. 26.
STRAIGHT STROKE.

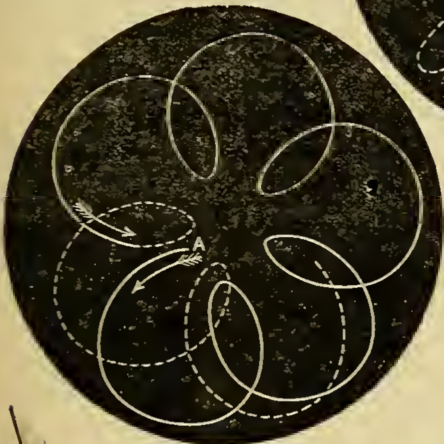


FIG. 29.
CURVED STROKE.

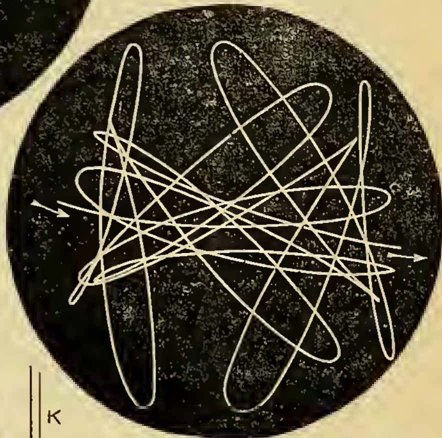


FIG. 31.—PATH TRACED BY CENTRE OF SPECULUM OVER TOOL IN ROSSE MACHINE.

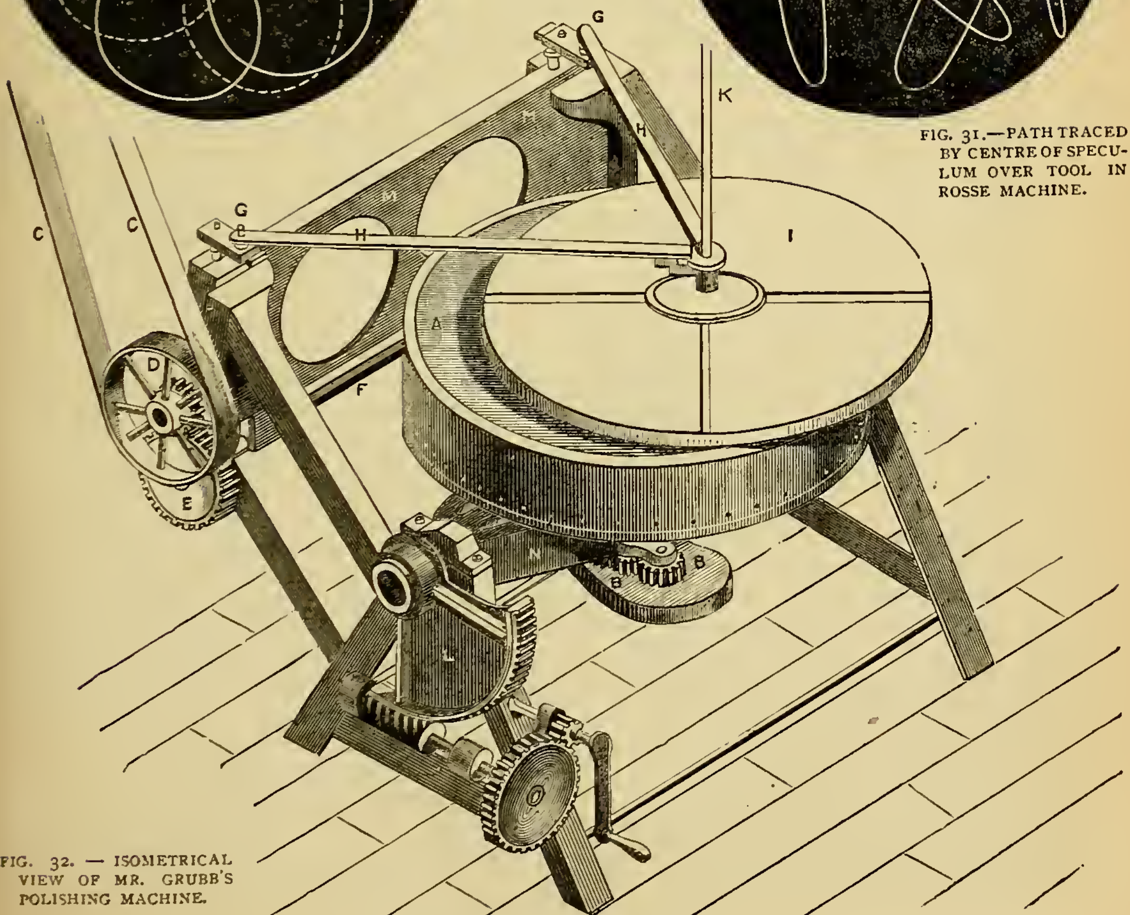


FIG. 32. — ISOMETRICAL VIEW OF MR. GRUBB'S POLISHING MACHINE.

to make a perfectly direct stroke by passing through the fixed guide F.

The second motion, rotation of the speculum, is obtained by a series of pulleys connected by bands from K, where the force enters the machine, through M and O to Q. The latter pulley Q is on the same spindle that supports the table of the speculum.

Side motion, the third requisite, is caused by the adjustable eccentric E actuated by the pulley R. This eccentric carries a guide G, through which the rod J J passes, and which is capable of rotating on its axis, which it would necessarily do every time the wheel E completed one revolution. When this guide is specially adjusted, it causes the rod J J, together with the polisher, to oscillate from side to side as much as may be required.

The rotation of the polisher, the motion which completes our list of requirements, occurs without any mechanism, since it lies perfectly unconstrained in the ring which expands from the rod J J. The polisher is loosely connected with one arm of the lever S, which, having its other arm weighted, allows the pressure of the polisher on the speculum—or the speculum on the polisher, if the positions are reversed, as would be almost advisable for a beginner—to be increased or diminished at will.

The dimensions following are those of a machine for a speculum 3 feet in diameter. By maintaining the same proportions a smaller machine may be accurately constructed: Pulley L, 30 inches in diameter; M, 7 inches; N, 18 inches; O, 9 inches; P, 18 inches; Q, 36 inches; R, 30 inches.

The whole of the machine may be successfully formed of hard wood, if the ends of the spindles and the bearings are protected by thin brass tubing. Fig. 29 illustrates the path of the centre of a speculum over the tool in a Rosse machine, and a comparison of that figure with Fig. 26 will at once show the manner in which the wear is distributed by a combination of the movements which I have demonstrated to be necessary.

A still simpler adaptation of the straight-stroke machine, suitable for attachment to the lathe, is shown in Fig. 30. It bears the name of the Rev. W. Hodgson, of Brathay. Probably it has been used only for very small specula three or four inches in diameter, the absence of any arrangement to create side-motion, rendering it unsuitable for larger sizes. But though that effect could be rectified by any skilful mechanic, it is only as a pattern of a lathe attachment for small specula working that the machine is here presented.

The polisher A fits in a ring, as in the Rosse machine, but the ring here is joined to a strong catgut band B B B. To the overhead motion of the lathe is attached an eccentric pulley C, over which a final loop of the gut-band works. Evidently, as the eccentric rises and falls, the band B B will rise and fall with it, and, passing around the grooved pulley D, this vertical action is converted into a horizontal one. At that end of the band most distant from the eccentric is a steel spring E, which, acting in opposition to the pull of the eccentric, gives a continual straight-stroke motion to the polisher. The second requisite motion, rotation of the speculum, is obtained by means of a tangent screw running between the centres of the lathe, and working in an endless screw cut in the edge of the table carrying the speculum. This table revolves in a socket in the casting F, which is bolted to the bed of the lathe.

The third or side-motion is, as before noticed, unprovided for: but it may be observed that the standard carrying the grooved pulley D could be easily modified, by providing it with an adjustment such, that the worker (who must in any case be present during the whole time of the polishing) might by a slight movement create the required variation in the direct stroke.

For the fourth motion the polisher rotates automatically in its ring. The terms "straight stroke," "side-motion," and "rotation" of the speculum and of the polisher have been explained. If at any part that explanation is obscure, the writer must plead the difficulty of attempting to teach by description that which actual experiment can alone properly teach, and must request the reader to study the paper carefully through once again at a future time when the results of actual experiments are fresh in his mind.

There remains to explain one other term to which we shall frequently have to refer, namely, curved stroke. The difference between curved and straight stroke will be evident from a comparison of Fig. 26 and Fig. 31. Any attempt at minute explanation of this stroke must fail. Having the discs before you, place the centre of the upper disc slightly out of the centre of the lower (*e.g.*, the point A in Fig. 31); then with one hand only resting on, or rather grasping, the upper, move it in a line over the lower disc, similar to that shown in the figure, walking slowly round the bench meanwhile. It will be necessary to partly support the body by resting the unoccupied hand upon the edge of the bench. To perform the circular stroke properly there should be cemented to the back of the speculum a handle small enough to be grasped by the hand (see Fig. 18 *et seq.*, page 57).

A speculum can be excellently polished by this stroke alone: witness Lassell's machine, which gave a continuous series of curves somewhat smaller than those of Fig. 31. But the second machine of Mr. Grubb is that which has been selected as a typical curved-stroke machine. It is shown, with certain

detail unnecessary for small specula omitted, in Fig. 32.

The speculum A rotates on a vertical spindle, which, passing through the casting N, is connected with and actuated by the wheels B, B, and those wheels are connected by means of a belt with the shaft F. The power is applied by the belt (or by hand in a machine of smaller proportions) to the wheel D, which gears into E. The cogwheel E drives the shaft F, which is connected at each end by two equal bevel wheels, with the spindles of the eccentrics G, G. The rods H, H, working from the pins of the eccentrics, are, with the latter, adjustable, so that the polisher I can be moved in a great variety of curves over the speculum. As in all cases where the tool is very large, it has to be relieved of a part of its weight, and this is effected here by the rod K, which is counterbalanced by a lever, as in Rosse's machine. The mechanism at L is self-explanatory, being simply for the purpose of raising the speculum from a horizontal to a vertical or any intermediate position to facilitate the testing.

It would not be necessary in a small machine, but has been permitted to appear in this illustration as a refinement which would always be useful.

The iron framing M, M, which carries the working parts can be raised or lowered with respect to the other parts of the machine to admit specula of different thicknesses to be worked.

The machine when complete would cause the centre of the tool to traverse a line over the speculum very similar to that in Fig. 31, except that the curves would be less likely to overlap.

Taking Fig. 32 as a guide, and rejecting all parts not absolutely necessary, a machine as simple as that of Lord Rosse, but admitting of a far greater variety in stroke, might easily be constructed.

With respect to the use of a machine in amateur speculum working there is one important item—the cost of labour—to be taken into consideration. If the amateur is incapable of preparing the patterns and finishing the castings, it is very probable that the payment of labour to construct a machine similar to that in Fig. 32, would exceed the cost of a speculum of the required size by a known maker. On the contrary, if the amateur optician is also an amateur engineer or a skilful wood-turner, the careful construction of the machine would furnish a pleasing occupation. But let him not think that, by forming a machine he escapes the necessity of thinking ; for a complete knowledge of the varieties of stroke and the manner in which they influence the figure, are as necessary to him as to the hand-worker, and in one sense more difficult to attain, for he must learn by experience the exact effect on the curve of any given alteration in the position of the eccentrics that govern the length and the description of stroke.

My final advice, then, is—if a single speculum only is required, work by hand ; if the manufacture of more than one is intended, and you have the necessary inclination to construct the machine, by all means construct it; but, in any case, a beginner should work his speculum, face downwards, by hand, and so discover exactly what a machine has to do.

From this time forth—for we begin work in earnest in the next paper—the worker should keep a written record of his working, so that in the end the means of obtaining any required effect will be simply a matter of reference. Nor think, that in advising this, the writer is becoming too exacting. Was it not he whose example was quoted in the opening lines of the first of these papers, who was able, "by a long induction from innumerable experiments, *all minutely recorded*, to communicate at pleasure an elliptic, parabolic, or hyperbolic form to his specula, or to change any of those forms at will"? And can we do better than follow in his footsteps ?

(*To be continued.*)

GLASS PAINTING AND DECORATIVE GLAZING.

By L. L. STOKES.

III.—APPLIED COLOUR—BITING IN—FIRING—RE-TOUCHING—LEADING.

APPLIED COLOUR.—It is now, if the subject demands them, that applied colours are to be used. In figure subjects it is usual to make the faces, hands, and any other flesh which may show, of plain white glass, and these have now to be brought to the proper flesh tint with china-pink or flesh-red. The tracing colour is allowed to become thoroughly dry, and the red, ground up with spirits of tar, is then brushed on. This operation must be done quickly, or there will be danger of softening and brushing up the mat. It is not well to lay on the flesh tint too heavily ; the effect of too high a colour is cheap and poor. If a deep or sun-burnt complexion is required, it is better to reinforce the pink with tracing colour than to try to gain the desired effect by excessive use of the pink alone. In using this tint, as in all applied colours, the tyro will at first be perplexed and misled by the difference of effect produced by it before and after firing. But on this point he will presently gain that insight from experience which he can derive from nothing else.

In using gold-stain ,there need be no fear of brushing up mat or lining, for this colour has to be applied to the *back* of the glass. The piece to be stained has, of course, to be detached from the easel and laid down flat on its face. This stain, as above mentioned, is made of silver dissolved in nitric acid, and alone it would be too thin for convenient use. To give to the solution sufficient body and solidity, as well as to enable it to be seen more distinctly by the operator, it is usual to mix and thicken it with well-ground red ochre. Dipping a brush in the solution thus mixed, an outline is drawn round the 'portion to be stained, and the colour is then floated over the space marked out. By "floating," is meant pouring a sufficient quantity of fluid on any surface, and allowing it to flow freely and equally wherever it may be required.

FIG. 10.—MEDALLION—SUIJECT FOR MATTING AND GOLD STAIN ON WHITE GLASS.

Gold-stain on white glass produces, when fired, a beautiful and brilliant yellow; and the possession of this stain, which can be used with so much ease, places a most valuable resource at the disposal of the glass painter. By means of it he colours the letters of inscriptions, enriches borders, picks out the veins of his conventional foliage, and in many other ways aids his work. In medallions, where the head is painted on a disc of plain white glass, the gold-stain is often made to serve as a general background. In grisaille work, which is commonly some sort of diaper in tracing colour on plain glass, gold-stain comes in to enliven the effect, and to relieve it of the appearance of monochrome; indeed, it is only in practice that the full value of this resource can be appreciated. In Fig. 10 we have a design in which the effect is to be produced in tracing colour on plain glass, with a liberal use of gold-stain in the ornaments of the figure.

Biting-In.—Among the many uses of gold-stain is its employment in connection with the process known as biting-in. It not unfrequently happens that the design demands the production of small white or yellow spaces in the midst of pieces of deeply-coloured glass; as for instance in the Beauchamp shield, Fig. 11, in which the field is red, and the fesse and croslets gold. The fesse (the bar across the centre) might, of course, be leaded-in with yellow glass, but not so the six little crosses. After what has been said under the head of "cutting-out," the enormous difficulty of cutting and leading together such forms may be realized. By biting-in, however, the production of this shield in its proper heraldic tinctures is reduced to a very easy matter. For the whole medallion, a disc of red *flash* glass is taken, and its film of colour is removed in the spaces occupied by the fesse, crosses, and light portion of the border, by the action of an acid. This leaves them *white*. By the after application of gold-stain, the bearings on the shield can be readily coloured yellow as required.

The process of "biting-in" is in most respects sufficiently simple, but it demands care. It is as follows: on the *coloured* side of the flash glass, over all those parts which are *not* to be exposed to the action of the acid, a coating of Brunswick black is spread. This is a convenient material for painting upon the glass, and its bituminous nature enables it to resist acids; whilst for the protection of the back and sides of the glass a mixture of beeswax and tallow is melted, and well coated over them. Not a speck of glass, except in the parts to be bitten, must be left uncovered, or it will assuredly suffer.

The only known chemical which will dissolve glass is fluoric acid, formerly and perhaps still prepared by pouring sulphuric acid upon that beautiful mineral found in the Peak of Derbyshire, and known as Blue John or Fluor Spar. As no glass or earthen vessel will hold fluoric acid, it has to be kept in a bottle of gutta-percha; and a tray of the same material, of a sufficient size to hold the pieces of glass to be treated, must also be procured, or a bank of tallow and wax may be raised on the edge of the glass itself. (See "Gilding on Glass," Vol. III., page 151.) The gutta-percha vessels are very inexpensive; fluoric acid costs about 2s. a pound. For use, for our present purpose, the latter has to be diluted with about an equal bulk of water.

The prepared glass is laid in the tray, and the diluted acid, in quantity sufficient to well cover it, poured over it. It is well that this should be done in the open air, as the fumes generated during the process are neither agreeable nor wholesome. Caution is also necessary with regard to the acid itself, for if it touches the skin it is liable to cause sores; and it is well to oil the hands before beginning the work. Whilst the acid is doing its office, the glass should be watched—care being always taken not to inhale the fumes—and as the slightest suspicion of grease may serve to keep any part of the glass touched by it from being properly acted upon, it is well to aid the operation by rubbing the surface occasionally with the end of a stick, wrapped with cotton wool. The glass should not be allowed to remain in the bath a moment longer than is necessary, or the acid will undermine the edges of the bitten-in work, and render them rotten and ragged.

FIG. 12.—FITTING THE LEADS.

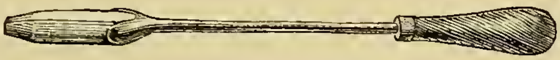


FIG. 13.—COPPER BIT FOR SOLDERING.

An immersion of ten minutes or thereabouts will serve to eat away the film of colour on most flash glass.

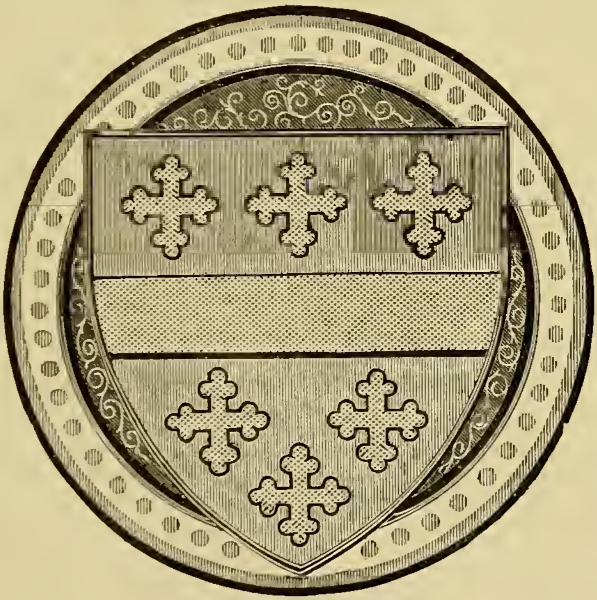


FIG. 11.—HERALDIC MEDALLION—SUBJECT FOR MATTING AND GOLD STAIN ON WHITE GLASS.

The pliers should be used for removing the glass from the tray, for it will not be prudent to touch the acid with the fingers; and it should at once be well washed with cold water, to free it from all trace of acid. After the wax and Brunswick black have been cleaned from the glass with turpentine, and all traces of this oily spirit removed with whiting, it will frequently be found that the edges of the bitten-in parts show some irregularities; but these can generally be hidden by touching up with tracing colour, and especially so if the glass is to be matted. In the medallion before us, the shield itself has no mat, but the edges of the bitten-in parts are strongly outlined with tracing colour. The background may, however, be matted, to produce a darker and duller red, and its decoration may be produced by lining in black tracing colour, or by scraping away the mat with the box-point; or the background may be shaded with tar-spirit colour only. Finally, the fesse and crosses are turned to yellow by the application of gold-stain *behind* the glass. The light circle of the border is left white.

A knowledge of the biting-in process renders apparent the peculiar value of flash glass, without which the qualities of fluoric acid would be of little importance to the glass painter.

Firing.—The almost imperishable nature of painted glass is in a great degree owing to the fact that the colours are fused with the ground on which they are laid, and so become a portion of the glass itself. The process by which this fusion is effected is technically known as "firing." So much of the painting as is possible at once having been completed, the glass is ready to be fired. The kilns at which this is done are usually iron ovens, fitted with ranges of sliding shelves, also of iron. Each of these shelves is covered with a bed of dry powdered whiting, which is made perfectly smooth and even. Upon this bed of whiting are laid the pieces of glass to be fired; these are in like manner covered with dry whiting; and the kiln is then heated to a point which, though not sufficient to melt them, is hot enough to render them quite soft. This due amount of heat having been reached, the kiln is cooled gradually: too rapid a change of temperature being liable to crack and injure the glass.

Some amateur glass-painters go the expense of a private kiln, but this is a luxury beyond the general reach, the cost of such a kiln being from ten pounds upwards. Others resort to a cheap contrivance for firing their own glass on a small scale, which is known as a "muffle." This is, so to speak, a portable kiln in miniature. It is an iron box, fitted within like the kiln, with iron shelves, which have in the same manner to be covered with whiting, to receive the glass. And here it may be observed that if the amateur does his

own firing, he must look to the perfect smoothness of his layer of whiting, otherwise the glass when softened by the heat will fall to and assume the inequalities of the bed in which it rests, and will come out bent and uneven. The muffle, when filled, is placed in a strong fire, and the coals are heaped up over it, the annealing being effected in much the same manner as in the kiln. With the muffle, however, it is not possible to fire large pieces or many at a time, and complete success can scarcely be looked for till some little experience in managing it has been gained.

It is, all things considered, the writer's opinion that the amateur glass-painter will act more wisely if he does not attempt to fire his own glass. He will save himself both money and disappointment by sending his work to the kiln of a professional painter ; he will not be charged more than about sixpence per square foot. Mr. Parkes, of 40, *Foley Street*, *Langham Street*, *London*, *W.*, charges sixpence per foot for figure-work, and fourpence per foot for other glass, and the firing at his kiln is satisfactory. Distance from a kiln is, with our rail and parcel post facilities for transit, a matter of no importance, and the glass will travel to and fro in perfect safety if each piece be wrapped separately in tissue or other thin, soft paper, and tightly packed in a box with so much dry sawdust as will prevent every piece from touching the box or any other piece.

Re-touching.—After the glass has been removed from the kiln, it will need well washing, and has then to be examined against a strong light. The operator may consider himself exceptionally fortunate if under this examination no faults appear. It is more probable that he will find his lines and shadows in tracing colour grown faint in firing, and that they will need re-touching in places. To do this he will use his tracing colour mixed with tar-spirit. It is probable, too, that here and there a blister may have arisen under the heat of the kiln, which will have to be rubbed down with a piece of pumice-stone and water, the fault being afterwards touched over, and as far as may be hidden, with a little additional colour, mixed with gum-water or with tar-spirit, as may be most convenient.

If gold-stain has been used, a coat of ochre will remain on the back of the glass, which will have to be washed off with turpentine. The operator will then be able to see the effect of his stain. He may find it too faint, and if so, he will have to apply a new coat of stain to the place. The flesh tint also may be found to require strengthening, and it may be well to note here that flesh red ought to have a light firing only.

These various touchings-up, if they are required, will, of course, involve a new firing; and it is quite possible that after this second visit to the kiln, more touching-up and a third annealing may have to be resorted to. Such things as these necessarily render glass-painting a slow, and, when produced for profit, a costly art.

Leading.—The needful re-touchings and re-firings having been given to the various pieces of glass, they are ready for leading together. The string leads used are much narrower and more flexible than ordinary window leads, but are in principle much the same. The strip of lead may easily be cut with a sharp knife to the required length, and a blunt knife is used to fit in the pieces of glass to its grooves. In stained glass work, owing to the small size of many of the pieces of glass employed, joints are of frequent occurrence. They are made by bevelling off the flanges from the end of one piece, as shown in Fig. 12, and inserting it between the flanges of the other piece, which should be slightly opened to receive it. The two pieces are then ready to be soldered together. Before applying the solder, the surface of the lead is scraped bright with the knife, and to serve the purpose of a flux, a little powdered resin is sprinkled upon it. The solder is melted with a copper bit (Fig. 13), which after heating must be rubbed bright on a plate of tin, with a little resin and solder, before being used. It is well in this work, in which the joints are so numerous and small, to use the best solder, that is one in which tin preponderates. All being ready, the end of the strip of solder is laid on the joint, and melted into it with the bit. When cross-bars of iron (termed saddle-bars) are used to strengthen the work, ties of narrow lead have to be soldered to the lead work, ready for twisting round them.

If a good glazing-board has been provided, it will be found most useful in the leading and subsequent operations.

After the work has been leaded and soldered together on both sides, it is usual to treat it by a simple process called "cementing." This is done by pouring linseed oil over the sheet of glass mosaic, sprinkling powdered whiting into the oil, and working the two into every chink and crevice with a brush. When this has been done thoroughly, dry lamp-black is brushed over the whole, and the glass may then be cleaned. The cement is, in fact, a putty, which fills up the cracks and hides whatever defects there may be in the lead-work, and tends to bind the whole sheet firmly together. The black brings lead-work and putty to a uniform hue. Cementing serves also thoroughly to scour the glass, and thus assists the after cleaning of it. It may appear to be a somewhat dirty process for finishing the work, but it tends to produce the effect desired in an admirable manner.

(*To be continued.*)

HOW I FURNISHED MY HALL.

Being Part II. of "My Furniture, and How I Made It."
By MARK MALLETT.

I.—MY COMBINED TABLE, AND UMBRELLA AND HAT-STAND.

THE house which I had undertaken to furnish was, as I have already mentioned, a small one, and as is usual in small houses the entrance (by courtesy a hall, though more properly to be termed a passage) was small also, and more especially as regards width.

I could have wished it otherwise, for I must confess to a liking for a roomy entrance-hall, even though at the expense of space in other quarters. An amateur worker, who, like myself, delights in decorating his home, finds no part of the house on which he can labour to better effect than on a moderately spacious hall. But there I was, in a house not of my own planning. in the same situation probably as the majority of my fellow-workers, and having to make the best of a very narrow space—a fact which I had especially to bear in mind whilst designing my furniture.

My Combined Table, and Umbrella and Hat-Stand.—The front elevation of this is shown in Fig. 1, the side elevation in Fig. 2. The total projection of this piece of furniture from the wall is 15 inches only. Its height is 6 feet, its greatest width 4 feet. The table top, which is 2 feet 6 inches from the floor, measures 2 feet 4 inches from end to end; whilst at each end the umbrella-stand projects 7 inches beyond it. The upper part is furnished with nine brass hat-pegs 4 inches long, and in the upper panel is a square of looking-glass, measuring 9 inches at sight, and 10 in the rebate. Below will be seen two zinc troughs or pans to receive the points of umbrellas. The elevations, Figs. 1 and 2, are drawn to 1 inch scale.

The two chief uprights, which are 6 feet long, and which go against the wall, are 3 inches wide, and $1\frac{1}{4}$ inch thick; of the same width and thickness are also the two front legs, which are 2 feet 5 inches long. For the two large cross-pieces to which the legs are screwed, 3 inch strips are also used; but for these 1 inch board will suffice; $\frac{3}{4}$ inch would really be strong enough, but would look weak. These cross-pieces are simply laid upon the uprights, and screwed to them, as indicated, with round-headed screws.

The four pieces which frame the looking-glass are of the same width and thickness as the cross-pieces. Such of their ends as come in contact with the cross-pieces are simply screwed to the backs of the latter, their other ends are let into the uprights. A rebate, $\frac{1}{2}$ inch wide and $\frac{1}{2}$ inch deep, is cut in the back of each of these pieces to receive the glass and the thin board by which it is protected behind.

In the lower panel it will be seen that the space immediately above the table-top is filled with a piece of thin board, the ends of which are let into a rebate at the back of the uprights. The small cross-piece which surmounts this board may require some explanation, and is therefore given on 2 inch scale in Fig 3; this figure shows it from above. It is, as will be seen, secured to the two main uprights, and in its turn gives support to the two smaller uprights of the ornamental trellis work, which are mortised into it; the tops of these uprights merely pass behind the large cross-piece, and are screwed to it. The diagonal strips are bradded, or, better, fixed with small screws to the uprights. Explanation can scarcely be needed with regard to any other point in the superstructure.

In the framework of the table two of the most important pieces are the backboard and frontboard; and of the latter a portion is shown, on the 2 inch scale, in Fig. 4. The dotted lines upon it indicate where the end of the side-piece (B, Fig. 5), the leg, and the top of the spandrel come in contact with its back. The narrow portion at its end, which projects 7 inches beyond the top of the table, is for the support of the umbrella-stand, of which indeed it forms the front. The mortise, A, is for the tenon of the cross-strip, shown more plainly in the section, Fig. 5, and there marked by the same letter. This strip, which is 2 inches deep and $\frac{3}{4}$ of an inch thick, forms the side of the umbrella-stand, and against it the umbrellas lean, as shown in Fig. 1. The back of the stand is formed by a narrow projection in the backboard, corresponding to that in Fig. 4. Indeed, the back and front boards are precisely similar, except that the former has not the ornamental details. Both are of $\frac{3}{4}$ inch wood.

To render the construction of the framework more intelligible, a horizontal section of it, 3 inches below the top of table, is given on the larger scale, in Fig. 5. In this figure, C is the frontboard, and D the backboard, E, E, are the two back uprights, and F, F, the front legs. It will be seen that the backboard is fixed to the uprights with flat-headed screws, whilst the more ornamental round-headed ones are used to secure the frontboard to the front legs. A shows the side-strip, and B the side-piece, both of which are more fully to be seen in the side elevation, Fig. 2. The side-piece is of the same width as the front and backboards, and its bottom is ornamented in the same manner as the former. This piece is screwed to the side of the front leg, as shown in Figs. 1 and 5, and at its hinder end it has tenons, which pass through mortises in the backboard, and are then screwed to the upright, as

shown at E, Fig. 5. The side-pieces are also of $\frac{3}{4}$ inch stuff.

As the lower angles of the spandrels (H, H, Fig. 1) will have to be screwed through their edges to the legs, it is well to cut them from 1 inch board.

end, is screwed a board which forms a lower shelf. Its front edge is to be seen in Fig. 1, its end in Fig. 2; it is there placed some 10 inches from the ground. It is as wide as the space between the uprights and front legs will allow, that is to say, 11 inches.

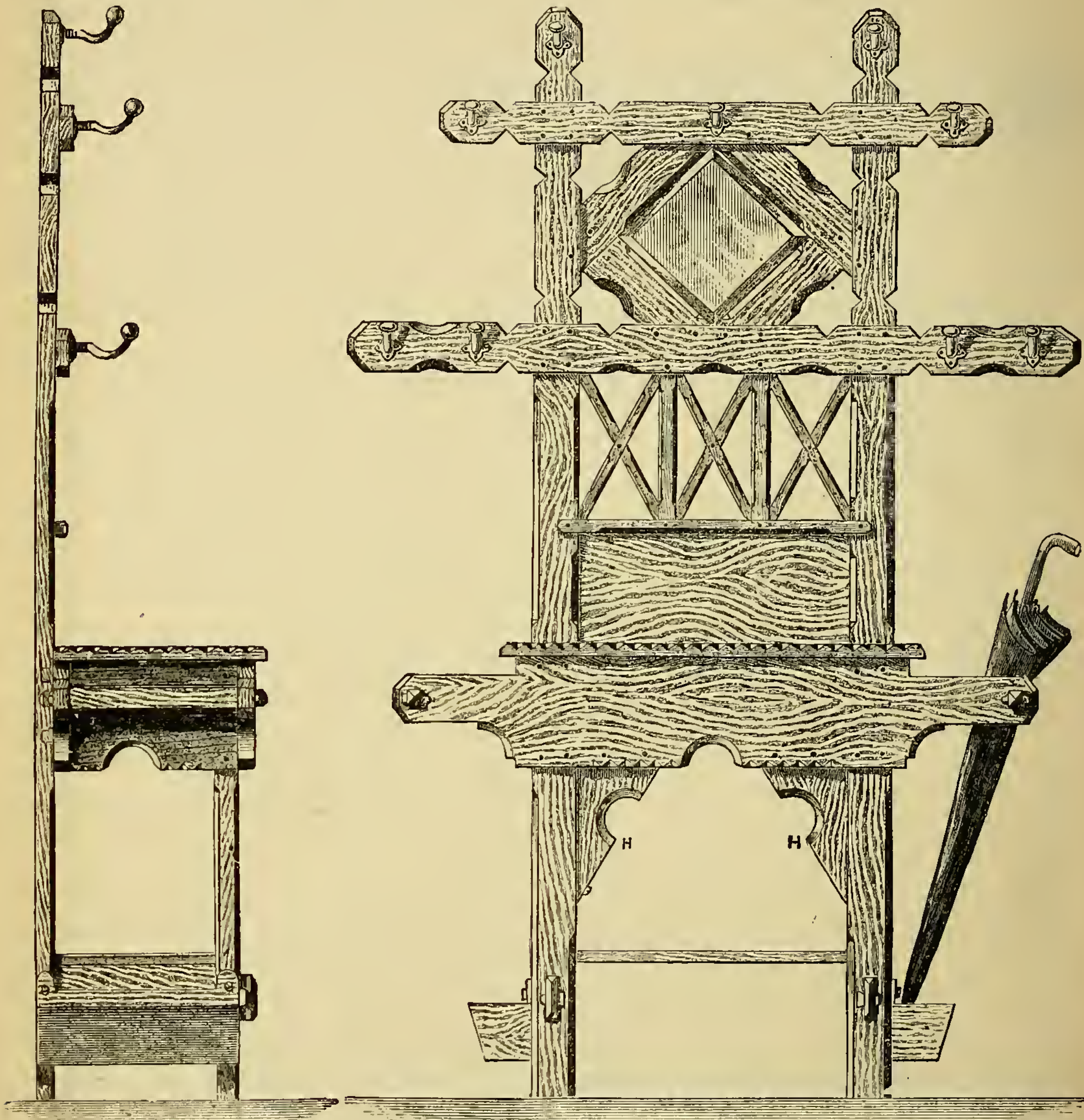


FIG. 1.—END ELEVATION. HALL TABLE, WITH HAT AND UMBRELLA-STAND. FIG. 2.—FRONT ELEVATION.

The top should also be 1 inch thick. It is given, drawn to 2 inch scale, in Fig. 6.

The uprights and front legs are connected near the ground by cross-pieces, which are mortised into both. Their exact width is immaterial, it may be, say, 4 or 5 inches; and on the top of these pieces, from end to

The two small pans or troughs to receive the bottoms of umbrellas, which are shown in Figs. 1 and 2, are best of zinc, and should be made by a zinc-worker. Each is hung on a pair of brass-headed nails or small hooks, driven into the outer sides of the legs and uprights. The dimensions of these pans

are, length $13\frac{3}{4}$ in., depth 4 inches, breadth at top 4 inches, and at bottom 3 inches. They are hung with their bottoms about 2 inches from the floor. It will be seen that the position of these troughs causes the umbrellas placed in them to lean away from the table, with which their contact, when wet, would be objectionable.

This piece of furniture will be found useful and easy of construction. I have given it as made by myself; but it may be made still more useful if the amateur carpenter is inclined to take a little additional trouble. It will be seen that beneath the table-top, the frontboard, back-

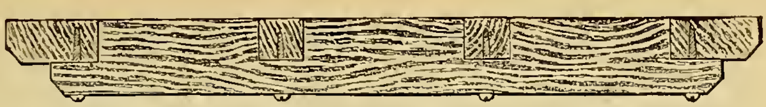


FIG. 3.—CROSS-BAR BELOW TRELLIS IN CENTRE.

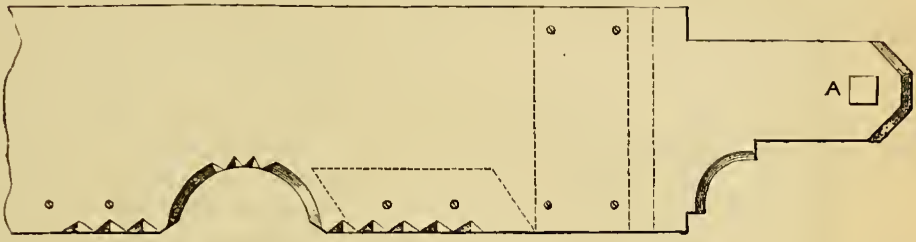


FIG. 4.—PORTION OF FRONT BOARD OF TABLE SHOWING END.

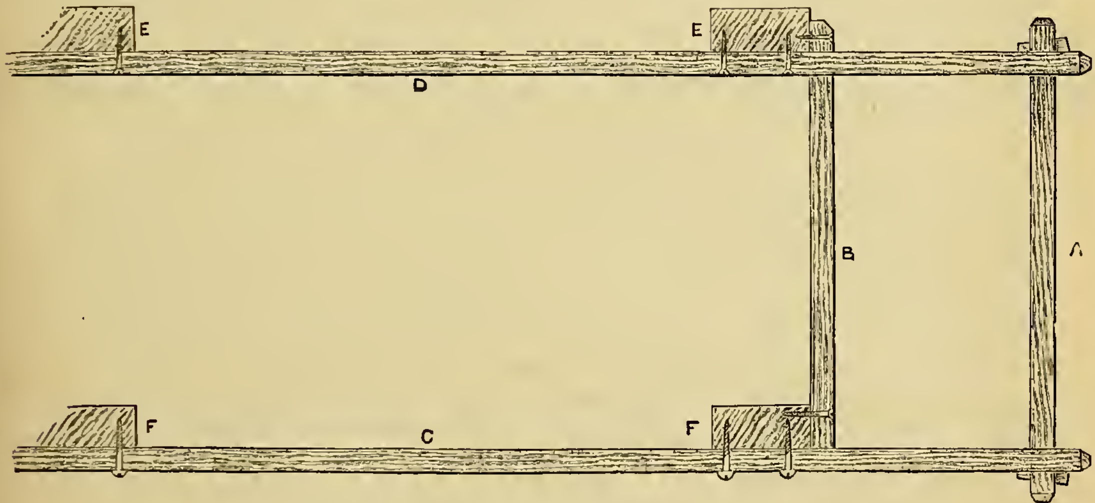


FIG. 5.—HORIZONTAL SECTION THREE INCHES BELOW TOP OF TABLE.

FIG. 6.—PLAN OF TOP OF TABLE.

board, and side-pieces form a kind of box, which might readily be utilized and turned into a locker by giving it a bottom. Access to this would be gained by dividing the table-top at the dotted line G, Fig. 6, fitting hinges, and making a lid of the front part. Or, with still a little more labour, a handy drawer might be contrived beneath the table-top in the depth of the frontboard.

CLOCK CLEANING AND REPAIRING AT HOME.

By OLLA PODRIDA.

III.—CLEANING AND RESTORING—REPAIRS.

INSTRUCTIONS for cleaning will now be given, and the different ways in which this may be accomplished fully explained. The first method consists of boiling the whole lot of gear—excepting springs, pallets, or other steel works which are tempered—in a strong solution of common soda. When thoroughly clean and free from all grease or dirt, take the parts out hot, and after shaking off the superfluous water place them in the oven, or by the side of the fire, to dry. Each part should be taken out and treated separately when quite hot, so that every opportunity may thus be given for the speedy evaporation of the solution. After having been dried thoroughly, each member must be well brushed with a small brush. An old tooth-brush will be found very handy for this purpose ; and it should be well applied to all corners and recesses which are likely to encourage the lodgment of dust or dirt.

As we have just noted, springs or other tempered parts must not be boiled; the reason for this being that boiling does not improve their temper, and, more particularly in the case of coiled springs, it encourages rust, which is very disastrous in its weakening effects.

The next method consists of the use of benzoline, naphtha, or spirits of wine, or even turpentine, as mediums wherewith dirt and congealed oil may be readily removed. Benzoline is to be preferred as cheapest and handiest. A small quantity of the liquid employed being poured into an old saucer, the parts of the clock are then immersed, and brushed thoroughly with any old tooth-brush or stump of a small paint-brush. Clogged or congealed oil and dirt will be found to disappear very quickly under this treatment. The odour may not be over agreeable to every one's nostrils, but the danger of engendering rust, which accompanies the first method, is safely disposed of.

The holes in the frame plates must also be thoroughly cleansed from all clogged oil and dirt. This will be readily accomplished by means of a small wooden peg, sharpened to the required fineness, inserted into the hole and twirled around, the twirling motion being sustained in the *same* direction while the peg is being withdrawn. To finish the holes out properly clean, the peg must be re-sharpened to finish each one. The springs must be kept well oiled, for protection against rust. This oiling may be more readily done in place while the springs are open, by brushing them over with a feather dipped in oil. The preceding remarks on cleaning apply to and include the alarum train as well as the "going" parts.

Every part having been thoroughly cleaned, the works may now be replaced. Lay down the back plate of frame with the pillars pointing upwards. Put in the mainspring spindle first, then the hour wheel or centre spindle, next the second spindle, followed by the third spindle ; lastly, put in the alarum spring spindle, striking wheel, and hammer spindle. The escape wheel must be put into position in the front plate before or while the latter is being entered on the pillars. In replacing the front plate, it must be dropped over the long spindle until it just "takes" on the ends of the pillars. The short spindles must then be carefully adjusted fair with the holes, and the front plate gently pressed down on the shoulders of the pillars. This done, replace or insert new pins in the ends at S, S. The pins may be made of suitable-sized wire cut to length. Failing wire, stout "domestic" pins may be employed, the heads being left on, and the pin shortened to the required length. In adjusting the spindle fair with the holes, an appliance similar to that illustrated in Fig. 8 will be found very useful. The sketch will explain itself, and the tool may be made out of a hairpin. With its assistance the spindles may be pulled or pushed about with facility. The open part of the eye must be large enough to admit the largest part of the spindle.

FIG. 8.—APPLIANCE FOR ADJUSTING SPINDLES.

The star wheels and pin on alarum spindle may now be replaced. In doing this, see that the stars are in their proper relation according to the marks which should have been made. The pallets may now be put in place, and the bent arm at C restored to its position on the end of the pallet stud. Now replace the pendulum wire, first slightly oiling the flat "feather" part at the upper end when it hangs in the "cock" or stud. After replacing the wire, the slit must be closed : this may be done with the pliers.

Except for oiling, the works are now ready to be

replaced in the case. In oiling, great economy must be observed, as the oil must be distributed very sparely. The end of each spindle or working part requires but the tiniest drop. Excess of oil encourages the deposit of dust, any accumulation of which, especially in conjunction with oil, being detrimental to the time-keeping qualities of the clock. The oiling may be easily and economically effected with a wire or fine camel-hair brush. The spindles, as has already been observed, require but a tiny drop on the ends, and during the application of this the frame should be held in a horizontal position, so that the spindles occupy a vertical position. The faces of the pallets must also be moistened. The pallet faces only require oil; the teeth of the escape wheel do not require individual attention, as the pallets during contact will share and distribute sufficient to properly lubricate the escape wheel teeth.

A drop of oil must also be applied to the spring spindles at the bearing in the "great" wheels; also a little on the inside of the eye on the end of crutch where it receives or embraces the pendulum wire. The stud or pin carrying the pallets and crutch must not be overlooked during the oiling process.

The works are now ready for returning to the case. Before replacing the works in the case, remove the clamps from off the springs. If these clamps have been properly applied according to the instructions already given, their removal will be a matter of little difficulty, and may readily be accomplished by applying the key and winding up the spring a little, when the clamp will slip off sideways.

The works may now be replaced in the case. In doing this, lay the case upon its back in a horizontal position, and place the works inside in the proper position, and exactly as they were before removal. This should have been noted before they were removed in the first place, and pencil marks made upon the back of the case at the corners of the back plate of frame. By adopting the precaution mentioned, some little trouble may be avoided in setting the pendulum, of which more will be said presently.

After screwing the works into the case, the procedure will be exactly the reverse of that described in taking to pieces. The dial plate must first be replaced and tacked or screwed, as the case may be, into position; next the disc for alarum must be slipped on the hour wheel pipe or tube, followed by the hour hand; and, lastly, the minute hand must be pinned on.

If the hour hand fits very tightly upon the hour-wheel pipe, care must be taken to ensure that it occupies a position exactly opposite one of the sides of the square for minute hand on the centre spindle. This is necessary, so that the minute hand may lie exactly upon twelve when the hour hand points the hour. In fixing the hands, make sure that they will clear each other, so that there may be no likelihood of their "catching" when the minute overtakes the hour hand. See also that the wire lever for alarum lies in proper relation to the disc, or rather that the disc has been placed properly in relation to the lever; the latter may, however, be bent a trifle one way or the other, to accommodate the former.

The foregoing having been successfully accomplished, the clock may now be replaced upon the mantel-shelf or wherever else it is required to stand, and the pendulum bob being hooked on after this has been done, a trial trip may be made that the result of the overhauling may be noted.

The "beat" or tick of the pendulum must be carefully observed, to see, or *hear* rather, whether it beats unevenly—that is, louder on one side than the other. If such happens to be the case, it shows that the clock does not stand "plumb," or that the works have not been replaced exactly in their former position inside the case, or that the pendulum or "crutch" wires have been bent. The latter causes are rather unlikely to happen with any degree of care. The readiest way of regulating the "beat" is by packing or wedging up the "heavy" ticking side of the clock, a piece of paper doubled to the required thickness being inserted under the base on the required side. The amount required will be ascertained by trial; but it may happen that, when this is accomplished, and the beat evenly balanced, the external appearance of the clock will be unsightly, owing to the case being "lop-sided." If this occurs, then the fault lies with the position of the works inside the case, and may be remedied by bending the end of the "crutch" *towards* the heavy beating side. This operation must be carried out carefully, and but little at a time, for fear of overdoing it; and during the process the dial plate had better be removed, so that the operator may see what he is about, otherwise the teeth of the escape wheel may suffer. It will be found advisable in most cases to try the "beat" before the dial plate is put on, although in the case of a domesticated clock, whose character is known, it is hardly worth while delaying the operation for this extreme remedy.

It is very likely that, while the clock was gradually becoming dirty, its time-keeping qualities deteriorated, and the pendulum adjusted accordingly. Most likely it began to lose, and to compensate for this the pendulum was shortened. Now that it has been thoroughly cleaned and properly restored, it will very likely commence gaining, to rectify which the pendulum must be lengthened by slackening the small milled nut which supports the "bob." This operation must be done a little at a time, and the result of each alteration noted, until correct time-keeping results.

Repairs.—These will obviously be few in number or consequence for the class or type of clock. The most likely and important would be in connection with the main or alarum spring. The hands are also likely to be broken, especially in the *fingers* of the amateur.

We will commence with the spring, taking the mainspring in illustration. These are to be bought for 6d. each, and may be obtained from Morris Cohen, 132, *Kingsgate*, *Leeds*, the purchaser paying postage or carriage, and sending cash with order. When received, the springs are bound with fine wire, or a bent piece of stout wire similar to that figured for the clamp. This wire need not be removed, as it will serve the purpose of holding the spring together until it is in place. Care must be taken in putting the spring on the spindle in the right way for winding up, also that the eye on the outer end is slipped on to the proper pillar in the frame. If this latter precaution is not attended to, the spring, in expanding, will open out amongst the works and bring the clock to a standstill. The same remarks apply to the alarum spring.

Broken Spring.—A broken spring may frequently be repaired in a serviceable manner, provided the fracture has not occurred at the inner end or eye which "takes" on the spindle. If the outer end be broken, a new eye may be formed by heating the extreme end and bending it while hot. If broken in one of the coils, the ends may be lapped over each other for a distance of $\frac{3}{8}$ inch or $\frac{1}{2}$ inch, and secured by means of one rivet. To do this, force out one end at a time of the break, and grip it firmly in a vice so that a small hole somewhat less than $\frac{1}{8}$ inch in diameter may be drilled through. This done, treat the other end similarly, taking pains that both holes shall be in the middle of the spring. Slightly countersink these holes on the outside of the lap, and prepare a short rivet of iron or brass. Force both ends out, so that the rivet may be inserted and closed. A spring treated in this manner will frequently give good results for a great length of time.

Hands, etc.—These may be obtained for 3d. per pair. Pendulum rods of all sizes are 1d. each. Screw wires for the clock under description are 2d. each. Alarum springs are 4d. each. The above is a list of those articles most frequently required, and are given at the prices of the manufacturer whose name has just been mentioned.

I now close this paper on the thirty-hour clock, trusting that some of the hints contained therein may prove of some use to my brother amateurs in this branch. I hope, before long, to return to the subject of Clock Cleaning and Repairing, and have something to say on the English clocks. Meanwhile I shall be happy to furnish any information, as far as I may be able, to any inquirer, through "Amateurs in Council."

HOW TO TURN A MANDREL WITHOUT A LATHE.

By J. L. DWYER.

I HAVE received so many applications for the mandrel, etc., described in my article, entitled, "A Simple Wooden Lathe," which will be found in page 132 of this Volume, from gentlemen who have not lathes in which to turn it for themselves, that I think it may be useful to many amateurs who may be in this predicament, to describe a method very similar to what I used when making my first lathe, by which the mandrel can be turned without the

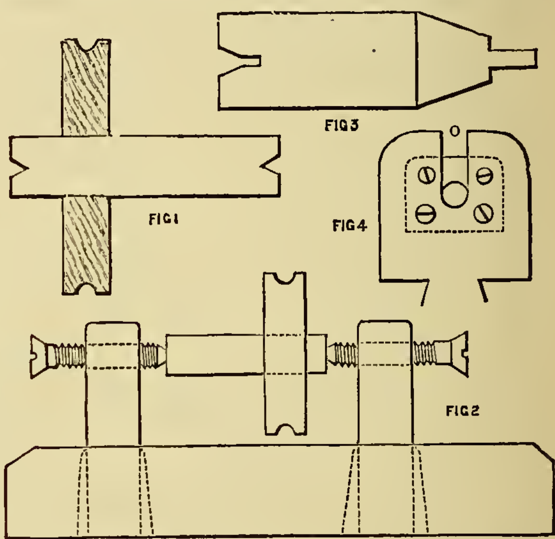


FIG. 1.—BAR, CENTRED, WITH WOOD PULLEY. FIG. 2.—BLOCK AND STANDARDS FOR TURNING BAR. FIG. 3.—MANDREL TURNED AND TAPERED. FIG. 4.—HEAD CUT TO RECEIVE BAR.

aid of a lathe. A simpler form of mandrel may also be designed to require as little turning as possible.

Let it consist of a bar of iron about 1 inch or $1\frac{1}{8}$ inch in diameter, and long enough for the mandrel. Let it be centred at each end, and a b of wood cut as round as possible for a pulley be driven on and permanently fastened. (See Fig. 1.)

Fig. 2 consists of a stout block of hard wood, having a couple of standards mortised into it. Two wood or other screws are passed through the latter, whose points engage the centres made in the iron. The stand and fly-wheel being supposed completed, a band driven from the fly-wheel to the rough pulley will impart rotation to the latter, and with some little difficulty the mandrel may be turned.

As a boy I turned thus a $\frac{1}{2}$ inch steel mandrel, *using only a bow.* In our case the pulley should be

at least 6 inches in diameter, and it, with the mandrel, may be turned by shifting the band when one speed is done.

The form of mandrel I suggest as requiring only the point to be turned, though, of course, if all were turned, the appearance would be much improved, is shown at Fig. 3. The taper ranges from 1 inch or $1\frac{1}{8}$ inch to $\frac{7}{8}$ inch or $\frac{3}{4}$ inch, according to length, about $\frac{1}{4}$ inch taper to 1 inch long; while the nose may be any size up to $\frac{5}{8}$ inch; but a shoulder of $\frac{1}{8}$ inch all round is desirable.

In order to avoid taking off the pulley, for it would be difficult to put it on true again, I would cut down a passage for it through the head, Fig. 4. This will not weaken the head anything to signify, and the space o could be easily filled up afterwards. I would only make the centres about 4 inches high. This will make it more solid. I may say in conclusion that after more than six months' work, my brother prefers it for light jobs to a 4 inch iron lathe.

NOTES ON NOVELTIES.

By THE EDITOR.

13. THE ENTERPRISE MEAT CHOPPER. 14. THE WINDSOR HAND BEADER. 15. THE WALKING BEAM SAW. 16. PATENT FLEXIBLE BACK HACK SAW. 17. THE "SHIPMAN" ENGINE. 18. SKINNER AND CO.'S PRICE LIST FRETWORK MATERIALS AND APPLIANCES, AND "COMPANION" LATHE AND SAW. 19. BROOK AND CO.'S APPLIANCES FOR REPOUSSE WORK. 20. MILLER'S FALLS COMPANY'S STAR HACK SAW. 21. THE HAYDON TOOL-HOLDER OR CUTTER BAR. 22. ZILLES' NEW PATENT ADJUSTABLE FRET-SAW FRAME. 23. MALEHAM'S AMATEUR FRENCH POLISHER'S COMPANION.

13. THE ENTERPRISE MEAT CHOPPER.—I said the other day that I intended to take an early opportunity of noticing some of the latest specialities introduced by Messrs. Charles Churchill and Co., 21, *Cross Street*, *Finsbury*, *E.C.*, and I am glad now to be in a position to redeem my promise. I should like to call attention, first of all, to the "Enterprise Meat Chopper," one of the machines introduced and made by the Enterprise Mannfacturing Company, *Philadelphia*, *U.S.A.*, of whose goods Messrs. Churchill and Co. keep a complete stock. The Editor of the "Practical Farmer," who most properly calls the machine a *perfect meat chopper*, describes the article and its capabilities in the following terms, and as from practical experience of the utility of the machine and the benefits to be derived from its aid in culinary operations, I can endorse every word of his statement. I give it here in preference to any description from my own pen:—"There are," says this gentleman, "meat choppers and meat choppers. Most of them are meat choppers in name but not in fact. They do their work well on paper but not on meat. Recently the Enterprise Manufacturing Company of this city, which manufactures a number of most excellent household labour-saving devices, sent us one of their Enterprise Meat Choppers, with the request that we give it a trial, and report just how the trial resulted, favourably or unfavourably, as the case might be. The claims for this Meat Chopper are briefly, that it does not tear or mangle the meat, but cuts it, somewhat as a pair of scissors snips off pieces of cloth or paper. The meat is fed into a hopper and forced through a cylinder by a screw, to a plate perforated with numerous small holes, the plate being brought close against a four-bladed knife which is attached to the end of the screw. The pressure of the screw forces the meat into the small holes, where it is chopped off by the revolving knife, which latter makes four cuts for each hole at each revolution of the screw, the meat being forced through the holes when cut, by the pressure of the screw. Everything contained in the meat, gristle, strings, or sinews, must be cut by the knives before it can pass through the plate, resulting in the cutting of the meat to a uniform size. This is the theory of the chopper. There is often such a wide difference between theory and practice, however, that we confess that we made a trial with the chopper with no very confident belief that it would do its work as well as claimed for it by the manufacturers. But we must candidly say that it did all that was claimed for it, and did it thoroughly and well. The toughest beef passed through it and came out chopped or cut uniformly fine, and in an incredibly short time. Another thing that commended it was the ease and thoroughness with which it could be cleansed. Composed of very few parts, it could be taken apart almost instantly, every piece being easily cleaned and put together again ready for use in a very short time. The trial convinced us that it could do all that was claimed for it, and that it was indeed a most complete substitute and improvement on the old style of chopping meat and other food for the table. We unhesitatingly recommend it as worthy of a place in every kitchen. Larger sizes than the one tried by us are made for use in kitchens, shops, hotels, and restaurants, while still larger ones to be run by power are manufactured for those who chop meat on a large scale."

A representation of the machine with the meat falling from it as it does, in a cascade of shreds, is shown in Fig. 1. To the description given I can add that it is useful for other purposes than that of chopping meat, for when vegetables are required for soup they can be chopped up finely by cutting them into junks and pieces and passing them through the machine. The consequence is that they go to pieces more quickly in boiling; and soup, which is sometimes wanted on short notice, can be more speedily and readily prepared. The juice which is expressed from the vegetables and is returned in the barrel of the machine can be added to the soup, as it contains all the flavour of the vegetables, and is therefore in itself an admirable flavouring. The Enterprise Meat Chopper, as it has been said, is made in different sizes, but No. 10, which will chop one pound of meat per minute, and is sold at 12s. 6d., is, perhaps, the most useful size for ordinary family use. One perforated plate only is supplied with each machine, but plates of other sizes may be obtained for about

1s. each, by means of which the meat passed through the machine may be chopped finely or coarsely as preferred.

14. *The Windsor Hand Beader.*—This handy little tool was only patented in the United States in March and June, 1885, and is therefore one of the most recent of the specialities offered for sale by Messrs. Charles Churchill and Co. It is intended for making small beadings and mouldings of different kinds, and will serve the purpose of the various scratches for beading, fluting, etc., that have been described in this Magazine, and will therefore rejoice the heart of the amateur, who is not able for want of time, will, or ability, to make a scratch for himself. The tool, as may be seen from Fig. 2, which represents the beader itself, two of the cutters that are used with it, and some of the mouldings, etc., that may be produced with it, resembles a spoke-shave or router in general shape, the cutter being fixed in the centre of the tool between the rounded handles, by which the operator holds it. It is less than ½ lb. in weight, and forms a desirable addition to any collection of tools, because it is eminently useful, and takes up but little room. Moreover, it is speedily adjusted and brought into use. The projecting point at the bottom is the guide, which is stationary, the cutter which is held firmly fixed to the tool by a nut, being adjustable on either side. To use the beader it should be grasped firmly, with the thumb of each hand resting on the semi-circular brass plate, shown in front. The cutter must then be rested at a slight angle with the work, and pushed along firmly. It may be drawn towards the operator by reversing the tool. By simply turning the thumb nut already mentioned, cutters of any design can be made to bear on the work, and at the same time any adjustment from the edge can be made. This beader will make beadings on curves and angles, and on irregular as well as straight surfaces, as shown in the illustration. It is supplied at 6s. 9d., but cutters for large beadings can be had at an additional charge. As the cutters are circular, a great variety of patterns can be obtained in each, the cutting parts to produce various patterns being ranged round the circumference of the cutter.

15. *The Walking Beam Saw.*—This is an improved Fret Saw of American manufacture, and is, to the best of my belief, the latest machine of this kind that has been brought under the attention of fret sawyers. It is on sale at the establishments of various dealers in machinery, tools, and appliances for fret work, but as Messrs. Churchill and Co. were the first to mention the machine to me, and to give me an opportunity of examining it, it is only fair that I mention the name of the firm in connection with it, as being those from whom I have derived the earliest information respecting it. I hope soon to have expressions of opinion on its merits from those correspondents who may have bought it and worked with it. The general appearance and construction of the machine may be gathered from Fig. 3. It is made, as far as the mode of support and general principles go, very much on the lines of the Lester and Improved Rogers' Fret-sawing Machines, and combines the special merits that are attached to each of them. Fret sawyers have often complained of the difficulty of getting the saws in some machines to work with an up and down movement, that is always vertical, and never departs from a true perpendicular direction. In this machine the saw clamps work in slides, after the manner adopted in the more costly machines, the uniform and reciprocal action of the slides so as to maintain direct vertical strokes of the saw being secured by the operation by the beam arrangement, which is attached to the frame that holds the saw at the back, working on a pivot or stud, as may be seen in the illustration, and having horizontal arms proceeding from the ends of the beam thus attached to the frame, and connected with the slides. The machine is as firm and substantial as it looks, being made of steel and iron, with all bright parts, and the table nickel plated. The distance from the back of the frame to the saw is 17 inches. The longer and principal driving wheel is 12 inches in diameter. The table is supplied with a tilting attachment for cutting inlaying work, and the machine is provided with a drilling attachment and a blower, which, it is said, is not liable to get out of order. The weight of the machine is 35 lbs., and Messrs. Churchill and Co.'s price is 40s., although I note that in Messrs. Harger Brothers' Catalogue it is offered at 35s. Full instructions for setting up and working the machine are supplied with every one that is sent out.

16. *Patent Flexible Back Hack Saw.*—Those of our readers who are workers in metal, or who have used a hack-saw at any time for cutting metal, are aware that the blades are of highly tempered hard steel throughout, and apt to snap asunder under adverse circumstances, or when bent beyond a certain degree of temperature. Messrs. Churchill and Co. have recently introduced from the United States "something new" in hack-saws, in the form of blades with flexible backs, which are tempered by an entirely new process, which makes the teeth or cutting portion of the necessary temper, but which leaves the back flexible, or without temper, so that when the saw is in use it is impossible to break it. These saws are made in three grades—No. 1, for steel, wrought-iron, and cast-iron; No. 2, for brass, copper, and iron tubings; and No. 3, for solid brass castings. Persons ordering saws should state the purpose for which they are required, in order that they may be supplied with the right grade. The saws are made in seven sizes, increasing by 1 inch each size from 6 inches to 20 inches. The price to buyers in this country will probably range from 2s. 6d. to 5s. per dozen, post free, but I infer this from the prices in America, and do not state it on authority. As the back of the blade is soft, if the saw blade happens to be too long for the frame, and most people use solid frames, it can be cut to the necessary length to fit the frame, and a hole drilled in the end that has been shortened. I can say that all that is advanced with respect to these saws is true. Messrs. Churchill and Co. showed me a specimen that was twisted far more than the blade exhibited in Fig. 4—twisted indeed so much that it looked, at first sight, more like a corkscrew than a saw blade. They also showed me another blade that had been twisted to the same extent, and had then been beat out, hammered flat, and brought into working order again.

17. *The "Shipman" Engine.*—Messrs. Churchill and Co. further wish me to say that they now have on view

No. 1 of these useful engines, which they will be pleased to exhibit to any reader of AMATEUR WORK who will favour them with a call at *No.* 21, *Cross Street, Finsbury, E.C.* I hope at some future time to give an illustration and a full description of this engine and its working. The fuel used is petroleum, which is drawn into the furnace in a curious and ingenious manner by atmospheric pressure, the spray from the tank being impelled through a large tube, from which it issues in tongues and curls of flame, that light up the interior of the furnace, and play on and about the tubes, of which the boiler is composed. The engine is beautifully made, and its price is now fixed at £20. I trust that those of my readers who are interested in motors of this description will take an early opportunity of looking at it.

18. *Skinner and Co.'s Price List, Fret-Work Materials and Appliances, and "Companion" Lathe and Saw.*—I am favoured by Messrs. J. H. Skinner and Co., *East Dereham, Norfolk,* with their "Illustrated List of Fret-Work Materials, Machines, Designs, Saws, Fretwood, etc.," which will be sent, post free, to any applicant on receipt of 4d. in stamps. It is now in the third year of issue, and from its appearance I gather that Messrs. Skinner and Co. have greatly increased their stock of appliances for fret-work and other specialities, adding cricket bats, etc., skates, and other articles which are more or less in demand in the changing season of the year. Among other appliances for fret-cutting on a smaller scale, and at cheaper prices, are the "Eclipse Hand Machines," with screw clamp for attachment to table. These range in price from 3s. 6d. to 9s. 6d., and seem likely to do good service to those who cannot afford one of the more expensive machines, if I may judge from the specimen submitted to me, which is illustrated in Fig. 5. The table of the machine, which is of polished hard wood, is secured to an ordinary table with the clamp. The saw, which works through a slit in the machine table, is adjusted and set in motion by the lever seen below. An S hook is attached to the lever, from which a cord can be suspended, with a loop at the bottom, into which the foot is thrust, the foot acting as a treadle to keep the saw at work. The upward stroke of the saw is caused by the recoil of a strong double spring to the right of the figure, below the arm to which the upper end of the saw is attached.

Passing on to the larger and more costly fret machines in Messrs. Skinner and Co.'s Price List, I notice among their stock Barnes' excellent "Velocipede Fret Machines," Nos. 1 and 2, the "Walking Beam Saw" of recent introduction, and the "Companion Lathe and Saw," a new speciality of the Miller's Falls Company, which is offered complete for no more than £2 2s. 6d., which is cheap enough in all conscience, and a price which, I venture to think, is barely remunerative to the sellers, but that, of course, is no business of mine. Messrs. Skinner and Co. have sent me one of these machines, just as it came from the makers, for the purpose of testing it, and I have much pleasure in saying that I consider it an efficient machine, and one that will prove a boon to amateurs with small means, who want to do a little fret-sawing and turning combined. The general appearance of the machine is shown in Fig. 6, in which the fret-saw attachment is shown in place for working. The lathe stands 2 feet 4 inches high, the bed is 2 feet long and 3½ inches broad, and the width of the legs at the bottom 1 feet 3 inches. The base is, therefore, large enough to secure stability. The legs are connected at the bottom by a bar ½ inch in diameter, on which the treadle is hung, being connected by a wooden bar with the large driving wheel, which has two grooves of varying depth on the face, to give a change of speed as the belt runs from it to the cone pulley on the lathe head. The higher speed is 11 to 1, the lower 7 to 1. The bed is dropped on to the legs and held in place on the right by a screw of ordinary form, with a nut and washer; but for this I myself shall substitute a round headed bolt and nut, because in my machine—and I have noticed that in some the construction of the bed differs slightly—it will be necessary to drop the tail-piece into the hole occupied by the screw, in order to obtain the fullest distance possible, namely, 15½ inches, between centres, and a bolt looks more business-like, and is more readily handled than the screw. At the other end of the bed, the lathe head is fixed by a bolt, nut, and washer, and keeps the left hand end secure and steady. The lathe head is provided with a 2 inch face-place, a spur centre, and a screw centre for turning cups. It has also a 4½ inch by ⅝ inch solid emery wheel, and a drill spindle, with set screw to hold drill points for wood drilling. The grooves in the cone pulley would be better for being a trifle deeper, but this is an improvement which can be easily effected. The tail stock has a screw-feed centre like modern engine lathes. It is provided with two rests—one for longer and the other for shorter pieces of work, three turning tools, wrench, screwdriver, twelve designs, one dozen saws, six drill points, etc. The swing of the lathe is 5 inches, or, in other words, it is a 2½ inch centre lathe. The scroll sawing attachment is secured to the lathe-bed by one bolt, and can be quickly put in place and as quickly removed. It is actuated by a pin projecting from the face-plate, which depresses the lower arm at every revolution of the cone pulley. The arms are of ash, bolted to an iron carriage, and give 18 inches in the clear. It has an automatic blower, a nickel-plated drilling table 8 inches in diameter, and an ingenious saw-clamp, by which the saws can be easily fastened or released when necessary. The machine is capable of doing all ordinary fret-work and work in three ply-wood. A glance through Messrs. Skinner and Co.'s Catalogue will show that they keep and supply every requisite that a fret-worker can require for finishing off the productions of his skill. Among these are some well made wood cramps and cutting boards combined, which are shown in Figs. 7 and 8, the former being sold at 1s., the latter at 9d. each, post free for 3d. extra, and a useful drill, 9¼ inches long, called the "Rapidity Drill," a variety, so to speak, of the Archimedean drill, whose speed is assisted by a transverse bar a little above the lower end, with a brass ball at either end. This tends to sustain the motion of the drill during the return upwards of the milled brass cylinder by which it is driven. A dozen drill points are supplied with the drill in a neat box, and the machine is sold complete for 3s. 6d. There are also mirrors of all shapes and sizes suitable for Messrs. Skinner and Co.'s fret-

work designs, in some of which mirrors are introduced. From specimens sent to me, I may say that these are of excellent quality, and beautifully finished. Each size is made in two thicknesses of glass, the thinner glass being cheaper, but the dearer showing a bolder bevel because stouter. The difference in price between the stouter and thinner mirrors is about 4 to 3, thus an oval mirror, 3½ inches by 2¼ inches, costs 8d. in the thicker material, and 6d. in the thinner; but my readers will be able to determine the prices of all sizes for themselves if they provide themselves with Messrs. Skinner and Co.'s useful price list. I notice that the firm distinguish their patterns as the "Eclipse" Designs. Among them, I notice some that I may speak of as being simple, pretty, and tasteful. I cannot say that the Naval and Military Designs, or the portraits of eminent persons, are exactly to my liking, but the groups representing the "Fight for the Standard, a Reminiscence of Waterloo, 1815" (shown in Fig. 9), and the "Charge of the Light Brigade, a Recollection of Balaclava, 1854," arc as good as any representation of this kind could be in so uncompromising a material as flat wood. The scroll work in the lower part of these designs seems somewhat slight in contrast with the solidity of the figures. Messrs. Skinner and Co. have an excellent collection of three-ply fret wood and fancy woods of different kinds for fret-work and turning, to which they have recently added pencil cedar, which, by the way, is a variety of mahogany, sequoia, an American fir wood of great beauty, and most desirable for panelling, and "Tasso wood," a kind of wood which I have not met with before, and which is not known to me even by name, or at all events, under this name. It is a beautiful wood, to judge from the specimen before me, richly variegated in the graining, and marked here and there by tiny knots, which add considerably to the general effect produced by the delicate pencilling of the grain. The colouring is rich, consisting of a variety of tints of reddish brown, ranging from a light hue here and there to dark and fine lines, which indicate the run of the grain. For panelling, this wood is as desirable as sequoia. I can testify to the excellence of Messrs. Skinner and Co.'s woods for fretwork, and especially their three-ply wood, or wood composed of three layers of veneers glued together—the only kind of wood in which it is safe to attempt the execution of intricate designs in fretwork. Another advantage in three-ply wood is that it does not warp as wood from ⅛ in. to ¼ in. often will. Messrs. Skinner and Co.'s parcel of samples sent to me comprise three-ply specimens of Tasso wood, sequoia, pencil cedar, bird's-eye maple, cherry, rosewood, satinwood, and walnut, with pieces of brown oak and white sycamore in the ordinary form. All the samples were of first-class quality. Messrs. Skinner and Co. supply fancy woods for turning, in assorted parcels of 12 lbs., for 1s. 6d.; 40 lbs. at 3s. 6d.; and 112 lbs. at 8s. 6d. Amateur turners should make a note of this.

FIG. 4.—PATENT FLEXIBLE BACK HACK SAW.

FIG. 9.—SKINNER AND CO.'S "ECLIPSE" DESIGNS. (*No.* 147.—"*Fight for the Standard.*"

19. *Brook and Co.'s Appliances for Repoussé Work.*—I have received from Messrs. Brook and Co., 10, *Featherstone Buildings*, *Holborn*, *London*, *E.C.*, the patentees of the Cheltenham Garden Engines, a box containing a set of tools for Repoussé or Raised Brass Work, with a book of patterns and instructions, and a piece of sheet brass, measuring 12 inches by 6 inches. The whole constitutes a sufficient outfit for those who may be desirous of seeing what they can do at this kind of work—a modern revival of an art which was highly esteemed in mediæval times, and which affords considerable scope for amateurs in carrying out decorative work of an attractive character—that may be applied to the ornamentation of doors, coal-vases, and other articles of furniture and internal fittings of houses. The box, with contents as described, is supplied at 5s. The patterns will be found useful as guides to the beginner, and the instructions, though brief, are to the point. The tools comprise a hammer, pliers, and a set of six punches of various forms. To my mind, the hammer seems scarcely heavy enough, and the head not too securely fixed on the handle. It is true, that in repoussé work the hammering should consist of light artistic touches, rather than a few hard blows: it is a work of gradual and graduated hammering, so to speak, but it will not be possible to accomplish work of a large and imposing character with too light a hammer. Messrs Brook and Co. supply larger and more complete sets of tools in wooden boxes at 10s. 6d. each, and judging from what I have seen of the smaller set, I should think these would be more suitable for amateurs, generally speaking. A full list of the requisite tools, with sizes of the matting, punches and prices, may be obtained from Messrs. Brook and Co., and the boxes may be had of any ironmonger in the United Kingdom.

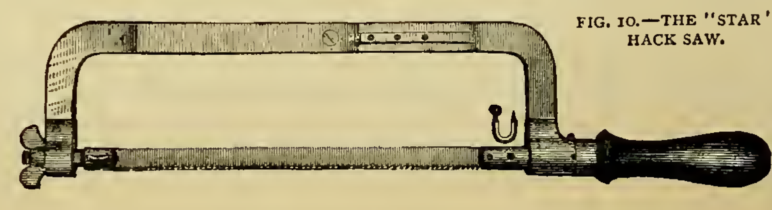


FIG. 10.—THE "STAR" HACK SAW.

20. *Miller's Falls Company's Star Hack Saws.*—Messrs. Richards, Terry and Co., 46, *Holborn Viaduct*, *London*, *E.C.*, have a

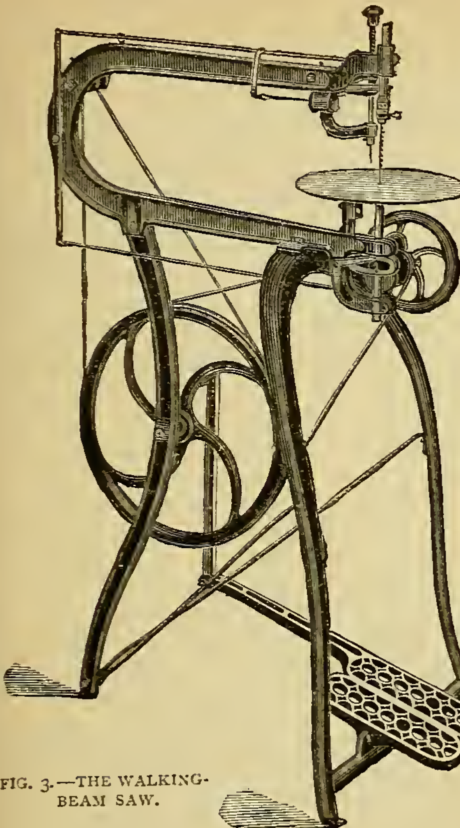


FIG. 3.—THE WALKING-BEAM SAW.

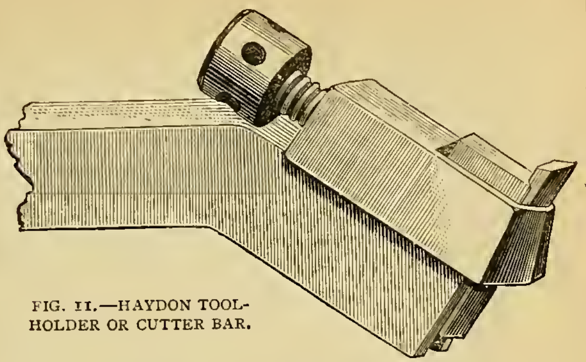


FIG. 11.—HAYDON TOOL-HOLDER OR CUTTER BAR.

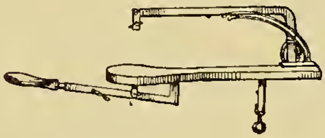


FIG. 5.—ECLIPSE HAND MACHINE FOR FRET SAWING.

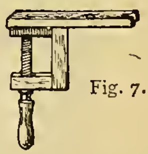


Fig. 7.

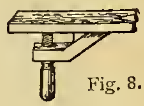


Fig. 8.

FIGS. 7, 8.—WOOD CRAMPS AND CUTTING BOARDS COMBINED.

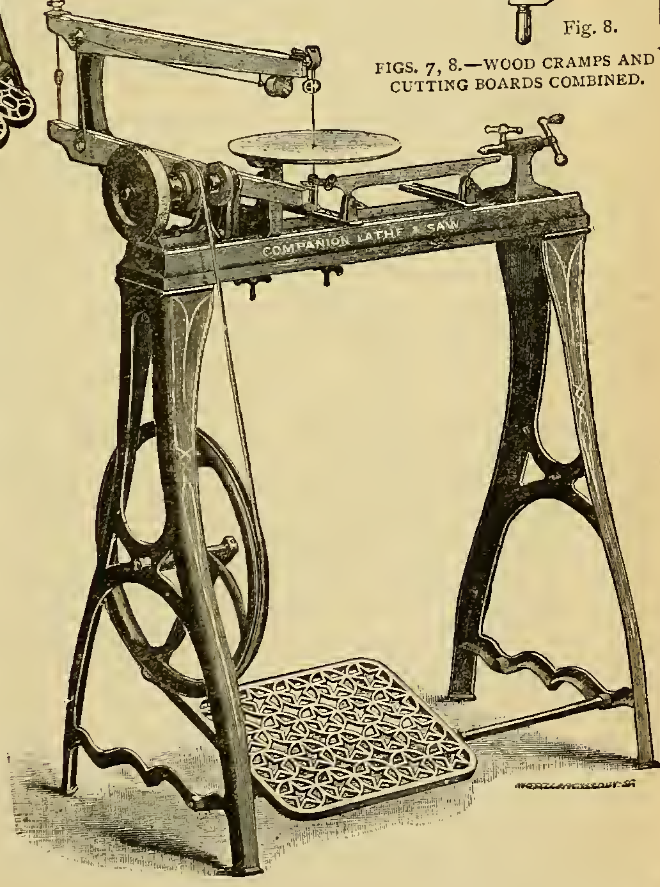


FIG. 6.—COMPANION LATHE AND SAW.

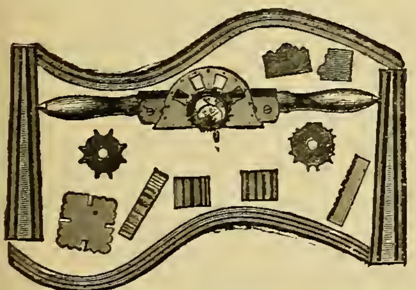


FIG. 2.—THE WINDSOR HAND-BEADER.

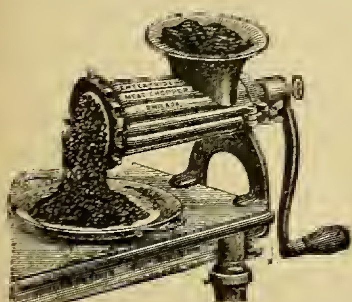


FIG. 1.—THE ENTERPRISE MEAT-CHOPPER.

number of useful hack saws on hand, which they offer complete, with half a dozen saw blades, at 5s. each; extra saw blades, if required, at 2s. 6d. per dozen. On examining a specimen of this hack saw, I find that it is the saw commonly known as the "Star Hack Saw," *solid frame*, nickel plated, which carries 8-inch saw blades, the length of blade that is most commonly used. The *extension frame* of this saw can be shortened or lengthened at pleasure, and carries all four sizes of saw blades made and used with the frame—namely, 6 inch, 7 inch, 8 inch, and 9 inch blades. I mention this to explain what I mean when I speak of the frame now under consideration as a *solid* frame. The merit of the Star Hack Frame is to be found in the fact that it is so constructed that the blade may be turned to cut in any direction, either upwards, downwards, to the right, or to the left. The blade is held in the frame by what is termed a staple pin, both arms of the pin passing through the frame, and one of them through the saw, but so made and arranged that they cannot fall out. The lower end of the steel bow of the frame works round the metal cylinder or pin that carries the lower end of the saw blade, and is notched with two grooves at right angles to each other, the notches dropping over a pin passed through the cylinder at the part at which it issues from the handle. The upper holder is partly squared, and fits into a square hole in the upper part of the bow, terminating in a screw, upon which works a wing nut, by which the blade may be brought to a proper tension. Thus, by releasing the saw and turning the square spill at the top of the bow, and then moving the bottom of the bow over the pin in the lower spill as required, the position of the blade may be regulated to cut in any of the directions mentioned above. The blades are extremely hard, and will cut iron with the utmost ease and rapidity. This hack saw is a saw which every amateur should possess, and they will do well not to miss the present chance of acquiring one at a rate below the ordinary market value. A representation of the saw, showing the patent staple by which the ends of the blade are held in the frame, is shown in Fig. 10.

21. *The Haydon Tool Holder or Cutter Bar.*—This djunct to the lathe manufactured by the Britannia Company, *Colchester*, and illustrated in Fig. 11, will be found to be of the greatest possible advantage to metal turners in many ways, and more especially because those who possess it are saved the expense and inconvenience of sharpening their own tools. Now this to all amateurs who turn their attention to work of this character, is manifestly a great saving of time and labour, and particularly beneficial to those who are not skilful in imparting a good finish and shape to their tools when they can and do make them themselves, and to those who are compelled to do their best in the home manufacture of appliances of this kind, because no smith is near at hand to do the work for them. The cutters used with the tool-holder are easily sharpened to the correct angle. As so much depends on this for imparting a beautiful, smooth, and bright surface to the metal, and giving a superior finish to the entire work, directions for sharpening cutters to the exact angle required for each particular metal, and for using the tools to the best advantage, are sent with each bar, or separately, to any address, for 6d. These instructions are accompanied by a diagram, showing the various angles for different kinds of metals. This diagram cannot fail to render the greatest assistance in preventing any mistake with regard to the angle, and with due attention to this and the instructions already spoken of, metal turners can hardly fail in obtaining the finish to their work that is so much to be desired. The cutters themselves can be purchased at 6d., and as they cost but little, and occupy but small space, a stock already sharpened can always be kept ready for use. Those, however, who prefer to make their own cutters, can purchase the steel in lengths of 12 or 14 inches, and cut off shorter lengths as requisite. The sizes and prices of the Haydon Tool Holder are as follows:—

Size of Bar.	Lathe Suited for	Price. s.	d.
$\frac{3}{8}$ inch	3 and $3\frac{1}{2}$ in. centre	9	6
$\frac{1}{2}$,,	4, $4\frac{1}{2}$, 5 ,, ,,	10	0
$\frac{5}{8}$,,	5 or 6 ,, ,,	10	0
$\frac{3}{4}$,,	6 and 7 ,, ,,	12	6
$\frac{7}{8}$,,	7 to 9 ,, ,,	15	0
1 ,,	above 9 ,, ,,	17	6

I may add that the London show rooms of the Britannia Company are at 99, *Fenchurch Street*. This announcement, I think, will be welcome and useful to amateurs residing in, or visiting, London.

22. *Zilles' New Patent Adjustable Fret-Saw Frame.*—I have received from Mr. Henry Zilles, 14, *South Street*, *Finsbury*, *E.C.*, a specimen of the New Patent Adjustable Saw Frames recently introduced by him. The frames at first sight look very much like the ordinary fret-saw frame, but on looking closely into them, several notable improvements will present themselves to view. The arms of the frame are 12 inches in length, and at the outer end of the lower arm is a handle, there being a elamp above it, and at the end of the upper arm, to receive and hold the saw. In the common frame the arms are in one piece, but in this they are in two pieces, joined together by a rivet at the back, on which they move. They are held apart and retained in their proper place by a strong C spring of steel. Now the advantage of this is that if a short saw be used, or even a picee of a broken saw, the upper arm can be bent towards the lower to accommodate the length of the saw, which connects the arms, but is itself held at the utmost tension by the spring. A catch is provided behind the rivet which joins the arms to prevent the frame from opening too far when a saw accidentally breaks. The price of the frame is 2s. 6d., post free.

23. *Maleham's Amateur French Polisher's Companion.*—In my notice of this useful article in page 187, I said that the materials were sent out in a *tin* box, which was neatly japanned. The specimen case that was sent to me for notice was of tin japanned, but Mr. Maleham has since written to me to say that the tin box is too heavy to admit of the "Companion" being sent through the post for the sum named—1s. 6d.—and that he has substituted a box of board which is as serviceable, and presents as good an appearance as the tin case.

AMATEURS IN COUNCIL.

**** For Instructions to Correspondents, see page 44 of this Volume.*

To Amateurs in Pimlico.

J. M. asks:—"Do you happen to know of any amateur mechanic in the Pimlico district who would be willing to allow me to use his workshop and work with him during the evenings? I am quite willing to pay a small weekly sum for the accommodation, and give good references. Should you not happen to know of anyone, will you be kind enough to insert a short notice to that effect?" [Amateurs writing in reply must send letter in envelope, sealed and stamped, and marked J. M. in lower left hand corner. I will then address and forward letters.—Ed.]

Treadle Fret-Machine.

Mr. John Henderson (*Station Terrace, Cramlington, Northumberland*) writes:—"I have designed and fitted up a Treadle Fret-Machine, in the construction of which I use a bracket frame and a sewing-machine stand. It has a true vertical stroke of the saw, and the tension on the saw is the same as in a bracket frame. It is easily and cheaply made and fitted up. I have several friends on the look out for a sewing-machine stand to fit one up like it. One of them has a fret-machine, but he prefers my pattern a long way before his machine. I am unable to draw, and I know no one who is able to make a drawing of it for me, as I would like to send a sketch and description of it to Amateur Work, as anyone who can get a sewing-machine stand will find no difficulty in fitting up a first-class fret-machine for doing plain work if they once saw my machine, or had it described to them. I cannot do inlaid work with it, as it is fitted up at present. If there is any amateur in my district who would be willing to sketch it for the readers of Amateur Work, I will be most happy to afford him every opportunity to do so." [I have given Mr. Henderson's address in the hope that some amateur in the northern counties who has time and inclination to examine Mr. Henderson's machine will do so and report upon it.—Ed.]

Wheelbarrow Making.

G. A. T. (*Folkestone*).—The author of the papers on "Making a Berceaunette Perambulator" promised long ago a paper or two on this subject, and I daresay he will redeem his pledge when business permits, for I know that he is a busy man. Meanwhile let me refer you to the instructions given on this subject in "Every Man His Own Mechanic," page 501, or in other words, in Part 8 of this Work, which any bookseller will procure for you at 6d. I am glad to learn that Amateur Work has proved useful to you.

The Britannia Company.

Flashing Dynamo writes:—"I have much pleasure in testifying to the good workmanship and moderate charges of that well-known firm, the Britannia Company. My lathe-head, which was in a very bad condition, I sent them the other day, and they returned it to me in a few days most beautifully finished. I was quite surprised at the workmanship they had put into it, and shall ever place reliance in them. My lathe now works magnificently, and I am sure my brother amateurs may rely on being similarly treated when entrusting anything to the Company's care."

Removal of Stains from Paper.

Inceptor.—You will find instructions for the removal of stains and discolorations produced in paper by damp and age in Chapter I. of Mr. John Brion's "Renovation of Old Prints, Drawings, and Paintings," Vol. III., page 370 (or Part 31, June, 1884). For this purpose Mr. Brion recommends "Holmes's Ozone Bleach," and in Chapter V., Vol. IV., page 83 (or Part 37, December, 1884), he says that he has found tartaric acid in the proportion of 2 drams to ½ pint of water, to be a safe and effective bleach for the removal of flymarks and general discoloration from paper.

Printing Pen and Ink Sketches.

F. F. McK.—The prints in imitation of pen-and-ink sketches, to which you allude, are first drawn by the artist in black ink, such as Indian ink, on white paper or Bristol board, which is better than paper for this purpose. The drawing is then photographed on zinc, and the photograph thus obtained is subjected to a chemical process which leaves all the lines of the drawing *in relief*. A block is thus formed, from which impressions can be taken as from type. If you wish to have any drawings prepared in this way for letterpress printing, write to Messrs. Pornot and Dougal, Photo-Lithographers and Photo-Zincographers, 1, *McLean's Buildings, New Street Square, E.C.*, and mention the name of this Magazine. You should make your drawing on a larger scale than that on which the block is to be; for example, for a block 2 inches square, make the drawing 4 inches square. It is then reduced to size by photography, and this has the effect of making the work on the block appear finer and more delicate. Armorial bearings and ornamental work for book plates can be produced admirably by this method for letterpress printing.

Addresses of Timber Merchants.

W. R. writes:—"In answer to your enquiry about timber merchants, I have much pleasure in bringing under your notice Mr. W. C. Ware, of *Little Windmill Street; Golden Square, W.*; *Lower Kennington Lane, Lambeth, S.E.*; and *Great Saffron Hill, Holborn, E.C.*, whose card I enclose. I have always had the best attention at the Little Windmill Street yard, and have obtained my wood at cheap rates."

Subjects in "Amateur Work."

W. H. R.—Every subscriber to Amateur Work has "a right to be heard," and I trust that I always do my best to meet their wishes, although the results of my efforts may not be always satisfactory or even apparent to those who are not behind the scenes like myself. You say that you asked some years ago for papers on Blacksmithing, Wire Working, and the Manufacture of Articles in Papier-Maché. In Vol. III., "A Few Hints on the Use of the Forge," which seem to have escaped your notice, were given by "Mulciber." In the present Volume a series of papers on "Smithing and Forging," by Mr. Edwinson, will appear. Thus you see I have never lost sight of your wish for instructions in smith's work, although it might seem to yourself that I had forgotten all about it. Again, I have actually accepted proposals for papers on "Wire Working," but since the necessary arrangements were made, I have heard no more from my correspondent. I can assure you that there are many subjects, simple, perhaps, in themselves, on which it is difficult to find a man who can write, and unfortunately when men are found, and agree to write, it is often as difficult to keep them up to the collar. Lastly, there are difficulties in papier-maché work that amateurs could not overcome; but at the same time I think it possible that means may be found for the execution of mouldings and ornamental work in paper at home. At present, however, the matter must remain in abeyance. I have answered you thus fully because you say, "I am glad to find you are *waking up* to give us an article on Papier-Maché work." I do not think there is much indication in Amateur Work, past or present, that I show a tendency to go to sleep over my work, or to rest unnecessarily on my oars. The delay in the treatment of any much-desired subject is annoying, I know, to those who are waiting for it, but from what I have told you I think you will be ready to concede that it is not I who am truly deserving of blame first.

Steel Scrapers.

Savant.—Carefully heat the scrapers to an *even* blood red, and plunge them into a bath of olive oil. Next heat a piece of iron to dull red, and after brightening the scrapers with sandstone or emery paper, pass them slowly over the heated iron so that they may be "let down" uniformly. When of a dark blue colour plunge them edgewise into lukewarm water. An old flat iron or heater out of a box-iron, or even the "*tallyern*" will do for a "letting down" medium.—Olla Podrida.

Recipe for Good Brown Stain.

Magnet writes:—"Having seen repeated inquiries for stains, I take the opportunity of informing my brother amateurs how I made a quantity of good Brown Stain. I procured from a friend of mine (a greengrocer) about 1½ gallons of walnut skins. These I put into glass jars and just covered them with water, and left them for about two months. The result was, as I have said above, a quantity of capital stain. If they had been boiled I have no doubt I should have made a shorter job of it, and possibly had the stain a trifle richer; but from the piece of wood enclosed stained with this stain and varnished, I think, Mr. Editor, you will say there is not much the matter. I hope this may be of use to someone." [The stain on the specimen sent is light, and presents a highly attractive appearance. Depth of tint may doubtless be obtained by repeating the application of the stain until the wood is judged to be dark enough. For my part I like the light stain.—Ed.]

Casting in Plaster.

J. C. (*Leeds*).—Before filling a *fresh* waste-mould the only thing necessary to prevent the mould and cast sticking together is to *thoroughly saturate* the mould with water. When *thoroughly* soaked, the only danger is that the mould will leave too freely, and so bring portions of the cast away with it. Piece-moulds cannot be used fresh, and to make them leave it is sometimes necessary to rub on a little hog's lard.—M. M.

Curious Effect of Size on Staining.

W. F. writes:—"I wish to express my appreciation of AMATEUR WORK, and to assure you that I, a practical joiner, have derived much pleasure and benefit from a perusal of its pages. I have bought one volume, and intend to purchase the others. The following may be of use to your readers, or at any rate may interest them: Having made for myself a kitchen sofa, of red deal, and wishing to stain it a light mahogany colour, I did so, according to your directions in Vol. III., page 79, viz., by applying a hot decoction of logwood chips. I gave it two coats, and thus produced a good imitation of mahogany. Now comes the strangest part of the affair. Previous to varnishing I applied a rather strong size, composed of common glue melted in water, in an ordinary iron glue-pot; this size I applied hot, and the effect of it was truly astonishing, for it turned my mahogany stain into the best imitation of walnut that I have ever seen. Now it is varnished it is truly beautiful, and I am sure no one could wish for a better, or obtain a more perfect, imitation of walnut. Can you explain this astonishing fact? Can it be because the size was prepared in an iron pot?" [Possibly the pot in which the size was prepared was somewhat rusty, and the presence of the rust would then affect the size and tend to darken the logwood stain previously applied to the wood. Try a series of experiments on small pieces of red deal, stained with logwood, as you stained the frame of the sofa, and then treated with size prepared in an earthen pot or pipkin, with an admixture of iron rust or iron filings, in various proportions, and also try size prepared with water in which some nutgalls have been boiled.—ED.]

Overglaze Painting on China.

H. S.—By smooth I suppose you mean glossy. Light painting need not necessarily be so, but it is best it should be so. Fluxing the colour, or glazing with flux, or a well-fluxed light grey for the last painting will do it. Such a glazing will not have the body of the glaze on underglaze work. Heavy painting should naturally be quite well glazed. (2) Absolutely it is not quite so permanent as underglaze, but practically it is quite as permanent. See Chapter I. (3) Very often the colouring is brighter. V., Chapter I. (4) As to the muffle, see Chapter XIII., in which firing at home is fully treated.—A. DE V.

Blue Printing Process.

MABUTA, who is located at *Estcourt, Natal*, sends two specimens of work done by the Blue Printing Process, which are the best of the kind I ever saw. They are playbills, relating to amateur performances at *Estcourt*, and are ornamented with grotesque figures done in capital style. Independent of the general excellence of the work, the playbills, which do credit to MABUTA's inventive power and execution, are remarkable for the depth of the blue ground, and the brilliant whiteness of the printing, writing, and ornamentation, the lines of demarcation between the blue and the white, clear, sharp, and well defined.

Electric Clock.

A. Y. S. (*Waterford*).—(1) The armature is to be made of soft iron, but the part it rests on does not want to. (2) The thickness of part B, page 61, does not matter at all, as long as it is firm. B, Fig. 4, gives a pretty good idea how thick mine is. (3) The thickness of wood in upright board is quite optional; if it is very thick, part C, Fig. 4, will have to be made broader, not to hinder the action of parts D, Fig. 2, and T, Fig. 1. I did not give exact measures, unless where it was absolutely necessary, so as to allow my fellow-readers to make use of every stray bit of iron or wood they might come across. The wood in my clock is ¼ inch thick. (4) The bobbin may be made of any non-conductor material. See page 324, Vol. I. Mr. G. Edwinson gives there a list of good and bad conductors. I did not enter into more details because I supposed that an amateur anxious to make an electric clock, however simple, must necessarily know something about electricity. I do not exactly understand what you mean when you say, speaking of the bobbin, that you suppose "that no hole is to be bored." There *must* be a hole in the centre of the core for the screw to fit in. See Figs. 1 and 2. You might rivet the bobbin on its support, if you like. (5) Of course, you must bore a few inches of wire out when you begin to lay it on, and a few inches when you finish; that is easily seen in Fig. 2. (6) About the making of bobbin, see answer to E. J. (7) Springs A, B, 6, T, Fig. 1, and D, Fig. 2, are made of brass. See answers to LEX. A, Fig. 2, is made of steel, but I think it might be made of brass too, keeping it a little thicker. H is made of wire, about as thick as it is drawn in Fig. 2. You will probably be obliged to make several before you hit on the right one, because its force and tension depend on the resistance of the other pieces that work against it. However, it would be a very small expense even to make twenty of them. (8) The pendulum is round, and as thick as on the drawing. (9) The "Cabaret" Battery is well known, at least in France; that was the reason why I did not describe it at first, and besides I did not know whether many readers would want me to do so; and in the third place, if somebody wants something, it is natural enough that he at least asks for it. For other queries, see answers to LEX and other querists.—L. M.

W. R.—See replies already given to correspondents on this subject in page 191 of this Magazine.

Painting Sponge Bath.

C. R. J.—If your sponge bath is to be used for sponging with cold water only, you may paint it with ordinary paint, but if soap and soda be used, with hot water, as in the case of a foot bath, the bath should be "japanned," as it is technically called. To do this, the colouring matter must be ground very fine in spirits of turpentine, and then mixed with shellac varnish. The metal must be perfectly clean, and from three to five coats of paint must be given, laid on carefully and evenly with a soft brush. Each coating of paint should be dried in an oven, heated from from 250° to 300°. You would find it most difficult, if not impossible, to accomplish this, for your only means of approximating to the treatment required would be to work before a fire in a warm and dry room.

Modelling in Cork.

G. S. N. (*St. John's*).—A paper or two shall be given on this subject as soon as opportunity offers. I shall be glad to hear from any reader who thoroughly understands this kind of work.

Miller's Falls Hand Drills.

F. M. Y. (*Ryde*).—There are two sizes of these drills known as the "Hand Drill," or "No. 1," and the "Large Hand Drill," or "No. 2." The former holds drills from $\frac{1}{32}$ inch to ⅛ inch in diameter, the latter holds drills of all sizes up to ¼ inch in diameter. With regard to the arrangement that is used for gripping and holding the *shanks* of the drills, the chuck that is used for this purpose has expansive jaws between which the shank is inserted, and the jaws are then closed by screwing up the chuck, as in the case of Barber's Patent Brace, whose special advantage consists in the capacity of the chuck to hold shanks of bits, reamers, etc., of all shapes and sizes, and to hold them true without fitting. If there is anything more that requires clearing up, kindly write again.

Castings in Brass.

F. W. (*Brixton*) writes:—"My thanks are due to G. E. G. (*Brixton*) for telling us amateurs where we can get our casting done cheaply. Last week I required a dozen castings of a bracket for which I had made a pattern, and took it to Mr. Gardner, *Wyvil Street, Wyvil Road, South Lambeth Road*, one evening, and the castings were ready for me the next evening. I found both Mr. Gardner and his son very obliging, and the metal (yellow brass) excellent. Mr. Gardner tells me he is casting a lot of work in a bronze of his own of a good gold colour, which does not tarnish. He assured me that some small finished articles of this metal were exhibited at the Inventions Exhibition by one of his customers, and they were as bright and untarnished at the close as when first placed there, while beyond occasionally dusting they were not touched. Mr. Gardner offers to undertake any castings in this metal, commencing at 11d. per lb. for large castings. I mention this as I think many would be glad to know of it." [Thank you for your communication. *Experientia docet.*—ED.]

Wood for Violin Making.

C. R. J.—You can purchase wood and tools for violin making of Mr. W. E. Hill, 72, *Wardour Street, London, W.* A list of the woods required, with prices, is given in Vol. II., page 232 (or Part 16, March, 1883), of this Magazine.

How to Dry Plants.

FLOWERS.—The following practical hints on drying plants are taken from an article on this subject, that originally appeared in the *Field Naturalist*, an American serial. It is from the pen of Mr. Leo. H. Grindon: "The very ancient adage, that if a thing be worth doing at all it is worth doing well, applies to the preservation of plants for the herbarium as much as to any great and important work of business. Specimens that are no better than fragments of brown stick, or that seem effigies of plants cut out of thin brown paper, the flowers shrivelled and shrunk so as to be no longer intelligible, the leaves crumpled and doubled up, everything confused and mashed together, such as one may see sometimes in collections, are altogether undeserving of the name. Nothing that is not dried in the best manner possible, its colours and configuration preserved as perfectly as the nature of the plant will admit, ought never to be allowed a permanent place in the herbarium; the bad may be tolerated awhile in default of better, but the further a specimen is from vivid and pleasing resemblance to the living thing, the speedier should be the endeavour to supersede it. Specimens from abroad that cannot be superseded of course we do not speak of. In the plants within reach, none but admirable representatives of their best features while alive should be considered worthy of a place. Plants dry very variously. Some require not a moment's trouble; others demand patience. Now and then the case is hopeless, and we are constrained to fall back upon the pencil, and prefer drawings, coloured ones if possible. Grasses and their allies, most kinds of ferns, plants that resemble heather, everlastings, the mature leaves of shrubs and trees, call for only the minimum. Those which try the patience, and can be managed only after considerable experience with easy ones, are such as may be illustrated by citation of the hyacinth. To secure the best results, obtain half a dozen pieces of stout millboard cut to about eighteen inches by twelve inches. Then gather together a hundred old newspapers, and fold them neat and square to about the dimensions of the millboards. Four or five yards of common white cotton wadding, a score of sheets of tissue paper and as many of blotting paper, all cut to the same size, completed the apparatus. One of the boards serves for the foundation; on this only a newspaper, then a piece of wadding, and upon this place the specimen intended to be dried. The cotton being soft and retentive, every portion can be laid in a proper and natural way, including the petals of the flowers. A newspaper above, two or three if the specimens have thick stems, and so on, till all shall be deposited in the way of the first. If the specimens are sticky or hairy, or of a kind that the wadding seems likely to adhere to, then, before depositing them on it, introduce a half sheet of the tissue paper. A heavy weight must be put on the top of all, sufficient to embed the specimens in the wadding; then leave the whole to rest for twenty-four hours. All the papers must then be changed, dry ones being put in their place; and if the plant seems to throw off a very considerable amount of moisture, such as will render the wadding quite damp, change the wadding also. A second and even a third change is desirable at the end of two or three days or a week; and when this is made introduce the blotting paper, pressing again till everything is perfectly flat, and the specimens are absolutely dry."

Violin Varnish.

SAVANT writes:—"On account of delay in obtaining my copy it was somewhat late before I noticed the remarks of PHILO-EDINENSIS on this subject. I have always been of opinion that the varnish was the weak point in Mr. Allen's otherwise cleverly-written papers. My experiments, however, did not cover the same amount of ground as PHILO-EDINENSIS', but they were sufficiently protracted to convince me that the arcanum of the Cremona Varnish did not lie in that direction. Besides, the toy-shop appearance it gave to the violin there was a flatness in its character that completely destroyed all the other essential properties it may have possessed. However, I did not lose altogether by the experiments. I had beside me a quantity of varnish made from fused amber. This varnish brought up the beauty of the wood remarkably well, but it lacked the ruby colour peculiar to the Cremona varnish. I tried what effect the admixing a little of Allen's varnish into it would have, and found after a few trials that one part of Allen's to three of the amber produced a shade almost to my ideal. I cannot speak as to the siccatine properties of the admixture, as it was only in October last that the idea struck me, and of course this season of the year is not favourable for the drying of oil varnish. When the warm weather sets in I shall have it put to the test and will communicate the result to our readers. I also tried Mr. Reade's method of varnishing with a result similar to that of P.-E.'s, only that mine cracked both back and belly, and imparted to the instrument a rather hideous appearance. It occurs to me that in the course of Mr. Allen's papers he gave the address of a London firm who supplied ready-made varnish. Would anyone who has tried this varnish kindly give his opinion thereon? Now that the subject has been opened in your columns, I should like that some one of authority would ventilate his opinion upon this vexing question."

Collection of Fancy Woods.

H. T. M. (*Balham*).—In making a collection of fancy woods, the better plan, probably, would be to obtain three slips of each kind measuring about 4 inches by 2 inches, and ⅛ inch thick, and to leave one piece plain, polish another, and varnish the third, and then mount the set on card, writing below the name of the wood, and any other particular you may like to place on record. You might thus show effectively the nature and capability of each kind of wood. Let me call your attention to my notice of "Decorative Wood Veneers" in Vol. II., page 240 of this Magazine (or Part 16, March, 1883, price 6d.) These veneers were to be seen at 72, *Finsbury Pavement, London*. Mr. Wilmersdorffer being the agent in this country for the exhibition and sale of them. I cannot say if he is to be found or the wood seen at the address given at this present time, but you can easily ascertain this by calling or dropping him a line. I mention this because Mr. Wilmersdorffer supplies (or supplied) albums of veneers at 18s. 6d. each, showing specimens of forty different kinds of wood used in the industrial arts, each kind of wood being represented by three veneers, cut in three different ways, and mounted on cardboard. The possession of such an album might save considerable trouble in collecting, as you might find it difficult to procure some of the woods contained in it.

Fret Work in Sheet Brass.

C. T. (*Dover*).—If you wish to cut fret work in sheet brass for the ornamentation of fancy articles, I think my notice of Mr. Henry Zilles' metal sheets for this purpose, which appeared in page 138 of this Volume, will materially help you. The patterns may be stuck on the wood with Le Page's Carriage Glue, which, it is said, is effectual for this purpose; or you can attach them to the wood with brass pins, drilling holes in the metal for the reception of the pins. For making boxes, if you wish for a perfectly even surface, you must braze or solder the edges of the strip or pieces of which the box may be formed. You can get excellent patterns for this kind of work from Mr. Henry Zilles, 21, *South Street, Finsbury, London, E.C.* If you use *solid* sheet brass, you can ornament it with the graver which is used on the metal for cutting out the pattern in grooved lines, curves, etc., with hatching and cross-hatching in some cases, as may be necessary in working out the pattern.

Plane Irons and Skate Blades.

IGNORAMUS.—Will any reader kindly inform me if there is any place where I can get the metal work for ordinary joiners' planes, etc.; also, if there is any place where I can get skate blades. I will be much obliged for quotation of prices if known. [By "metal work for ordinary joiners' planes" I presume you mean plane irons. Any ironmonger will supply you with these. Bailey's Patent Plane Irons range in width from 1¼ inch to 2⅝ inch, and cost—single irons from 1s. to 2s. each, and double irons from 2s. to 3s. 3d. per pair. These are made in six sizes. Plane irons of Sheffield make are made in eight sizes, ranging from 1⅝ inch to 2½ inches, each size increasing by ⅛ inch, the cast steel cut irons costing from 8d. to 1s. 1d. each, according to size, and cast steel double irons from 1s. 4d. to 1s. 11d. each. I have quoted prices as given in catalogue of Messrs. R. Melhuish and Sons, 85 and 87, *Fetter Lane, London, E.C.* I leave it to some of our readers to tell you where you can get skate blades; but I am inclined to think they are not sold retail, and that you must get a smith to fashion a pair for you.—ED.]

Model Engine Making.

A WOULD-BE MAKER.—A series of papers on this subject from the pen of Mr. J. Pocock is commenced in this Part of this Magazine.

Brass Fittings for Cameras.

A. S. (*Earlsfield*) writes:—"Having noticed repeated enquiries by brother amateurs as to where they can procure brass fittings for their home-made cameras, I am happy to inform them that they can procure the same from A. A. Pearson, 46, *Queen's Place, Leeds*, at the following prices:

MILLED HEAD SCREWS (with one nut each), $\frac{5}{8}$ in., 3s. 3d.; $1\frac{1}{8}$ in., 3s. 6d.; $\frac{3}{4}$ in., 4s.; 1 in., 4s. 9d. per doz.

CAMERA BOLTS (with two plate nuts), 4d. each.

TRIPOD LEG BOLTS (with wing nuts), 2s. 9d. to 3s. 6d. per doz.

TRIANGULAR BRASS TRIPOD TOPS, $\frac{1}{4}$, 19s.; $\frac{1}{2}$, 21s.; $\frac{1}{1}$ plate, 26s. per doz.

RACK AND PINION SETS (with racks not exceeding 10 in.), 6s. 6d. per set.

DOUBLE SWING SETS (consisting of six plates), 2s. 6d. per set.

HINGES.—(1) Focussing Screen (with bevelled edges), 4d., 5d., 6d. per pair, according to size; (2) Tailboard (polished), 3d. per pair, two sizes; (3) Side Flap (extra thin), 3d. per pair.

DARK-SLIDE CLASPS, 3d. per pair, or 2s. 6d. per doz. pairs.

Any other information will be readily supplied by Mr. Pearson himself, on receiving any queries, judging by his kind and obliging answers to me, in which, for my information, he sketched designs, showing how certain fittings were fixed, of which I was not sure of."

Armatures for Electro-Magnets.

J. W. (*Urmston*).—The armature of an electro-magnet for an electric bell must be of soft iron, and the spring of some non-magnetisible metal. Steel would soon be magnetised and cause the armature to stick to the poles of the magnet. Hard brass is best for springs. All other metals except platinum for contact pieces would soon wear away, being burnt by the spark made at the break. The difference in cost is not worthy the attention of an amateur.—G. E.

Articulating Skeletons.

INCEPTOR.—The usual way of "articulating" (putting together) a skeleton is by boring holes at the articulations (points of contact), and fastening the bones together with wire. The vertebræ are threaded on a wire of suitable size, which supports the head, and the other bones are attached in their natural position. INCEPTOR will need only pliers, bradawls, and wire, to be got at any ironmonger's; and a liberal supply of patience, which he must provide for himself.—G.-W.

Electro-Motor Driven by Current from Accumulator.

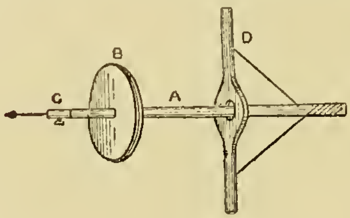
C. C. (*Stratford, E.*).—As accumulators can be made large enough to receive and retain great volumes of electrical energy, and, as the number capable of being arranged in series is indefinite, they may be employed to furnish energy to electromotors of any size. Tramcars have been driven by power derived from them, and boats have been propelled through the same agency. When you ask, "Can *this* or that thing be done?" I must in truth answer yes, it can; and much more be done than has hitherto been attempted in this direction. But now, coming to the second and practical part of your question, I must, I fear, give you such a reply as will tend to discourage you. An accumulator cannot be charged with current from a Bennett battery in volume large enough to work an electro-motor capable of working a lathe. If you have an electro-motor capable of working a lathe, employ electrical power direct from a Bunsen battery.—G. E.

American Clock.

A. J. (*Earlsfield*).—Your hair spring is too tight. If there is any spare spring projecting through the stud or "cock" in which it is pinned, release it and push it back. If this fails turn the washer or collar to which the inner end of the spring is secured, on the spindle around in the direction which will open or slacken the spring, always observing that the balance wheel when at rest is in the middle of its beat. The collar is only held by friction, and may easily be turned by means of a pair of pincers. The adjusting must be carried out by degrees until perfection is attained.—OLLA PODRIDA.

Simple and Effective Drill.

R. A. W. (*Dublin*) writes:—"I send you a sketch of a simple and effective drill, which may be of use to some of your



SIMPLE AND EFFECTIVE DRILL.

readers. The spindle A is made of any hard wood 9 inches long and $\frac{1}{2}$ in. diameter. The disc B is lead $\frac{3}{4}$ lb. weight, and $3\frac{1}{2}$ inches diameter, firmly fixed to the spindle. A hole is bored into the end of spindle for the drill points, which are held by a screw through the ferrule C. The handle D is of wood, and should move easily on the spindle, through a hole at the top of which is passed a string of gut, and knotted through the handle. On depressing the handle the string will uncoil (as shown in sketch), and the flyer revolve. On coming to the end of the string the action is reversed."

"Cabaret" Battery.

W. W. (*Horley*).—This battery has been described by Professor L. Marissiaux in page 191 of this volume, which see.

Slide for Cornice for Curtains.

G. T. H.—Referring to the slide and hooks represented in the plan of top of Cornice for Bay Window in "Every Man His Own Mechanic," page 334, any ordinary curtain hook will do. The slide and knobs, or buttons with rings or loops at the bottom, which work along the slide, you ought to be able to procure of any furnishing ironmonger. If you find any difficulty, write to Messrs. R. Melhuish and Sons, 85 and 87, *Fetter Lane, Holborn Circus, London, E.C.*, and refer them to the illustration in "Every Man His Own Mechanic."

Cement for Fixing Lamps.

E. J. W. (*Cannes*).—Replies on this subject were given in Vol. IV., pages 502 and 593; but as you are abroad and have not your copy of AMATEUR WORK with you, I may say that it is recommended to mix the plaster of Paris with a little weak glue instead of water. Another correspondent poured melted alum in the socket of the cup, and then placed lamp in it, and held it firm until the alum got cold. The lamp and socket should first be warmed.

Materials for Leclanche Cells.

BINGO writes:—"If any readers of AMATEUR WORK are making up Leclanché Cells, for which they require manganese and carbon, they could not do better than order from Mr. Blackwell, 26, *Chapel Street, Liverpool*, who supplies it mixed ready for use at 4d. per lb.; and all other requisites for electrical apparatus. I can recommend his goods, as I have just made an electric bell from instructions in Vol. I. with materials supplied by him. The bell works very well.

Model Yacht Building.

F. M. P. (*Bristol*) writes:—"As an amateur who has made a model yacht chiefly from instructions in AMATEUR WORK, I think I can advise anyone who is a novice at the work (like myself), of a surer method of getting correct shape of the hull than by the way given—namely, by boring with the bradawl into the block to distances measured on the water lines of the body plan, and then cutting down to end of the holes bored. This seems to me to be rather risky and uncertain, as it is very likely that many of the holes will not be bored straight—that is, at a perfect right angle to the side of the block; and a little bit out in this way must make it rather awkward on such lines as section, lines 1, 2, 7, and 8. I was advised by a friend of mine to make outside moulds from the body plan, as in the annexed diagram, numbering them from the lines of section, and applying them from time to time to the corresponding lines of section on the block as the work proceeds. Plain deal $\frac{1}{8}$ inch thick is best. They can be easily cut out with a fretsaw. By doing so, I have got my hull into quite correct shape, which I don't think I could have done by the other method—at least, not so exact."

MOULD FOR BODY PLAN.

AJAX.—Many thanks for pointing out what is undoubtedly a mistake, but only a slip of the pen. It will not make any great difficulty for a person who thinks about what he is doing, but for anyone that only sticks to words *as they are written*, it may cause a little bother. The $3\frac{1}{2}$ inches marked off from the centre is for the L. W. L., and not for the deck line, so that the model is 7 inches beam on the water line of whatever dimension one likes to make her over all.—A. C. H.

Roller Slide for Negative Paper.

LEX.—I have not yet had opportunity to use this new paper negative process, consequently, I cannot at present give instructions how to make a roller slide. I intend, however, experimenting with the Eastman films forthwith, and shall probably give a chapter on the subject (and may also describe a roller slide) at the conclusion of the series of papers on "Photography," now commencing in "ours."—C. C. V.

Soldering.

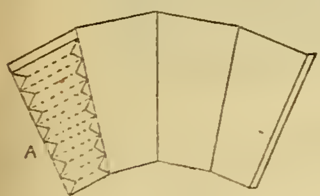
C. F. (*Hammersmith*).—You will find all the information you can require on this subject in Mr. Edwinson's papers on "Brazing and Soldering," in Vol. II. of this Magazine. Muriatic acid or "spirits of salts," in which as much zinc has been dissolved as the acid will take up, is used as a flux for the solder, may be bought ready for use, and which varies in its composition for different metals. Resin and borax are also used as fluxes.

Bird Stuffing.

INCEPTOR.—Should turn to our articles on "Preserving Animals" (see pages 466 and 507, Vol. III.), he will there find the directions as to the processes which he requires. Sets of instruments, at from 10s. to 30s., are to be bought at the shops of the principal naturalists; but most of the things required the worker may easily make for himself, exceptions being sharp-pointed scissors and scalpel, which are to be had at the shops where surgeon's instruments are sold, and at some tool shops. Tools and appliances are fully discussed at page 468, Vol. III.—G.-W.

"Kinnear" Bellows for Camera.

LEX.—The material must first be cut and marked, as in the accompanying illustration, the size required; four pieces of stout brown paper are then cut, as shown



"KINNEAR" BELLOWS FOR CAMERA.

at A; one piece is glued to each of the sides, and over the lot another piece of black twill or silica is glued. When dry it is folded at dotted lines (A). To do this properly LEX had better examine a bellows-body camera. Perhaps the easiest way to make a conical bellows is to have a box made the required size and shape, fasten the material tightly round it, and proceed as above. There is a good article on bellows-making in the current "Year Book," page 57, to which I refer LEX for further instructions.—C. C. V.

Capability of Organ Bellows.

H. W. (*Glasgow*) asks:—Would bellows 3 feet long by 1 foot 10 inches broad, one feeder, be large enough to supply wind for the following stops of a small organ Great Organ, Open Diapason, 8, 44 pipes; Stopt do., 8, 12 pipes; Flute, 4, 56 pipes; Swell Organ, Lieblich Gedacht, 8 56 pipes; Keraulophon, 8, 44 pipes; Flageolet, 2, 56 pipes. Pedal Organ, Bourdon, 16, 25 pipes. To this I must reply that the bellows would be scarcely sufficient to supply so many stops, especially as one of them is a Pedal Bourdon. I would strongly advise you to make the bellows either longer or wider, or both, if possible.—M. W.

Boring Cylinder in Lathe.

N. E. SIGNALMAN.—A cylinder can be bored in the lathe you describe by means of a boring bar, a tool which will be described in the series of articles on "Model Engine Making."—J. P.

Fretwork Patterns.

SCOTUS writes:—"I have no wish to enter on any question as to the relative merits of the designs of rival publishers, but would like to say a word as to the mode of printing them. Usually they are printed in black; now, I am of opinion that this is the worst way of doing them, as anyone who has tried any large pieces must have found there is great difficulty in seeing whether the saw is *just* within the black or some distance in. The reason being that the saw itself looks like a black line (and, of course, its shadow is black too), and it is self-evident that black on black is not easily seen. I would suggest to publishers of fret designs to print them like those sold by Mr. Henry Zilles, as being by far the best plan; and judging by the price these are sold at, not more expensive than the ordinary way. I would also, now I am at it, like to say a word on saws. Anyone who has ever cut any work —say 18 inches long—must have experienced the difficulty of cutting near the ends. As the work is turned round, there comes a time when you have to push your chair back and work the treadle with your toes. Now, this could be altogether avoided if we could get a saw toothed on both sides. I am aware that such are made; but those I have hitherto seen are very badly made; in fact, no fret cutter would be bothered with them. I am of opinion that a *good* fast-cutting saw made in this way is a desideratum. Its great advantage in cutting sharp angles without the necessity of turning the work round must be apparent to all." [Coloured inks are more expensive than black ink, and it is on this account that fretwork patterns are printed in black instead of brown, which is decidedly preferable to black. Saws are made with teeth on both sides, but I have never heard that they are regarded by anyone with favour, as if you attempt to do this on a narrow blade you weaken the saw; and if you increase the width of the blade, in order to have teeth on both sides, you increase the friction, and render cutting of intricate patterns all the more difficult.—ED.]

Making Up Old Carved Oak.

W. F. S. (*Leicester*).—From a strictly archæological point of view the use of bevelled glass in connection with carved oak would scarcely be correct; but as it is presumed that the object is less to deceive future antiquaries than to produce an effective and tasteful piece of furniture, there appears no valid objection to a judicious combination. If employing bevelled glass myself in this manner, I should prefer to use it in *small* squares only.—M. M.

Reversing Back for Camera.

LEX.—At the camera back, which is, of course, square, are two grooves (A, A, Fig. 1) into which slides the reversing frame (Fig. 2), which is also square. The rever-

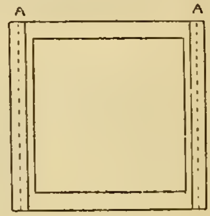


FIG. 1.—CAMERA BACK.

sing frame carries the grooves, into which the double back slides; by simply withdrawing the frame from the back of the

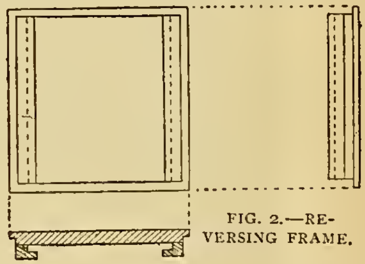


FIG. 2.—REVERSING FRAME.

camera, giving it a quarter turn and again inserting, the grooves are altered from an upright to a horizontal position, or *vice versa*.—C. C. V.

INFORMATION SUPPLIED.

Magic Lantern Slides.

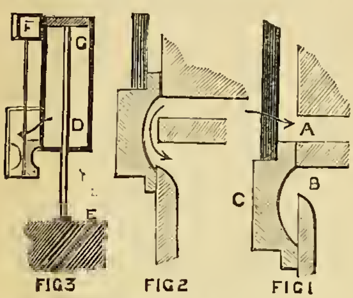
PROFESSOR L. MARISSIAUX writes in answer to R. J. S.:—"I know a way of making Slides for the Magic Lanterns otherwise than painting them on glass; but it requires a pretty good draughtsman to make them. I have made some which I found very satisfactory. The pictures, portraits, landscapes, etc., were drawn on very, very thin ground glass with ordinary pencil. It requires a little skill to execute the shading of pictures, but after some practice I think anyone who knows anything about and has a taste for drawing, can easily overcome the difficulty. You might try to draw the pictures on very thin and transparent tissue paper, which is gummed on the glass when perfectly dry. The tissue paper I mean is slightly yellowish, and has an oily appearance. The ground glass pictures have an advantage, as the drawings can be rubbed off and others drawn on instead."

The Rev. R. J. SIMPSON, *Melton Rectory, Roughton, Norfolk*, will be happy to give R. J. S. (see page 144 of this Vol.) any information on the manufacture of cheap slides, and will reply to any person who may like to write to him *direct* on this subject.

Model Steam-Hammer.

SCHOOLBOY, who writes from *St. Petersburg*, sends the following reply to NASMYTH:—"I do not know exactly how the

Woolwich steam-hammer is constructed, but I give here a method for letting the steam out and in, which is what NASMYTH wants most. In point of fact, the steam only raises the hammer, which falls by its own weight. The slide valve is depicted in Fig. 1. In the slide valve box is the slide valve C. A and B are two openings for the steam; A leads under the piston, B leads



MODEL STEAM HAMMER.
Fig. 1.—Slide Valve Box, showing steam passing under piston. Fig. 2.—Ditto, showing waste steam escaping. Fig. 3.—Rough Sketch of Steam Cylinder.

to a tube, which in its turn leads to the open air to let out the used steam. In Fig. 1 the steam is going under the piston; in Fig. 2 the waste steam is escaping. Fig. 3 is a crude representation of the steam cylinder, etc.; D is the cylinder; E part of the hammer (the stand I have not shown); F is a small cylinder always full of steam, which always keeps the slide valve in that position, that the piston G is kept at the top of cylinder D, and the hammer E is up. When it is wanted to use the hammer the piston in the cylinder F is pulled up by a lever, the pressure in the cylinder D ceases and the hammer falls. If I were making the model, I would use a weight to keep the slide valve down. Many steam-hammers are also made so that the steam helps to force down the hammer; but the way I have shown is the most simple for a model. This is mostly taken from Scholl's Fuhrer des Maschinisten." [I am sorry to learn that you "catch it" at school for bad drawing, and that the "catching" is of such constant occurrence that you must in point of fact be always kept on the *qui vive*. Let me offer a crumb of comfort by saying that your drawings are perfectly intelligible, and that I am obliged to you for your communication.—ED.]

Washed Para Rubber.

BENIAMIN writes in reply to MAD JACK:—"I have pleasure in stating that Washed Para Rubber can be procured from any india-rubber manufactory, but must add at the same time that it is not usually sold in this state. But in order to save you (or any other reader) the uncertainty of not being able to obtain it, I shall be pleased (upon receipt of address) to get him (or them) any small quantity. Being somewhat in the trade personally, I have better facilities than they. Price of same does not exceed 6s. per lb., and is very light in weight." [BENIAMIN sends his address, but not his name. Persons writing for Washed Para Rubber must send under cover to me an application in enveloped sealed and stamped, and marked "Beniamin—Para Rubber" in lower left-hand corner. Letters shall be addressed and forwarded as soon as BENIAMIN sends his name.—ED.]

Toboggan Sledge.

T. P. F. S. writes in reply to A. F. M. (*St. Andrews, N.B.*):—"Two views of the Toboggan Sledge are given in the annexed diagrams. Dimensions: Length, 4 feet to 8 feet; width, 18 inches to 2 feet, made of two thin, say one-eighth inch or three-sixteenth inch flexible, and strong boards (white cedar for preference) fastened across by four or more light transverse sticks stitched on with strong catgut, a twist of the same ligament secures the end which is turned up. Finally, two rods are tied along the edge to hold on by. This is the way in which they are made abroad."

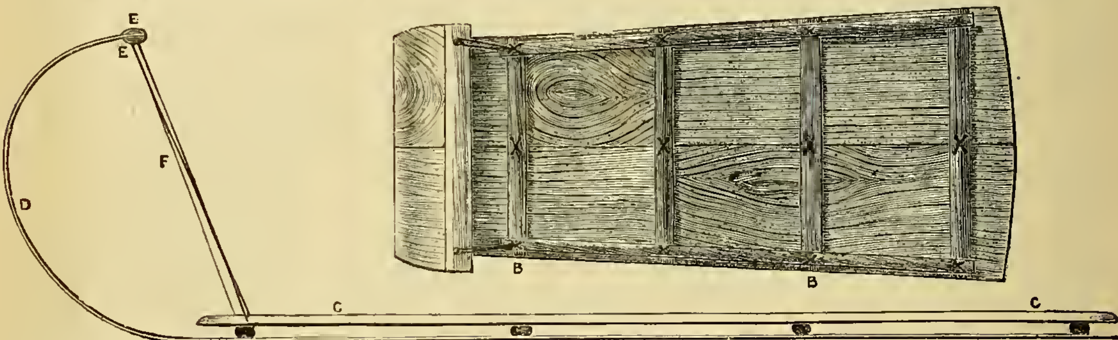


FIG. 1.—BACK VIEW OF INTERIOR OF TOBOGGAN SLEDGE.—A, Rounded End, inside; B, Cross Bars, flattish. FIG. 2.—SIDE VIEW.—C, Hand Rail; D, Rounded End; E, E', Two pieces of half-round wood to keep end from splitting and to fasten gut to. F, Catgut or Leather.

Celluloid for Organ Keys.

MR. C. W. LOWE (*Mansion House, Moseley, Birmingham*) writes:—"I notice in AMATEUR WORK an inquiry for Celluloid Organ Keys. I can supply them, but cannot give a general price, as scarcely any two sets are alike. I shall be happy to give lowest quotation on receipt of full description."

BURTON FLEMING writes in reply to JOINER (page 144), "That this material for organ keys, the latest and best known substitute for ivory, can be had of Messrs. Sehright and Clark, 16a, *Grafton Crescent, Castle Road, Kentish Town Road, N.W.*, at a cost of 20s. per row. They would supply a new set of ivories for 25s. JOINER is also referred to pages 184 and 446 in Vol. III. of AMATEUR WORK."

D. B. A. writes in reply to JOINER, "That Messrs. N. L. Van Gruisen and Son, Patent Piano, American Organ and Harmonium Manufacturers and Importers, 27 and 29, *Bold Street, Liverpool*, always keep celluloid in stock, and though not an article of sale with them until manufactured into keys for pianos, etc., they will be happy to supply any amateur with what he requires. They believe only one other firm in the kingdom imports celluloid for pianos, etc."

INFORMATION SOUGHT.

The "Harrington" Clasp.

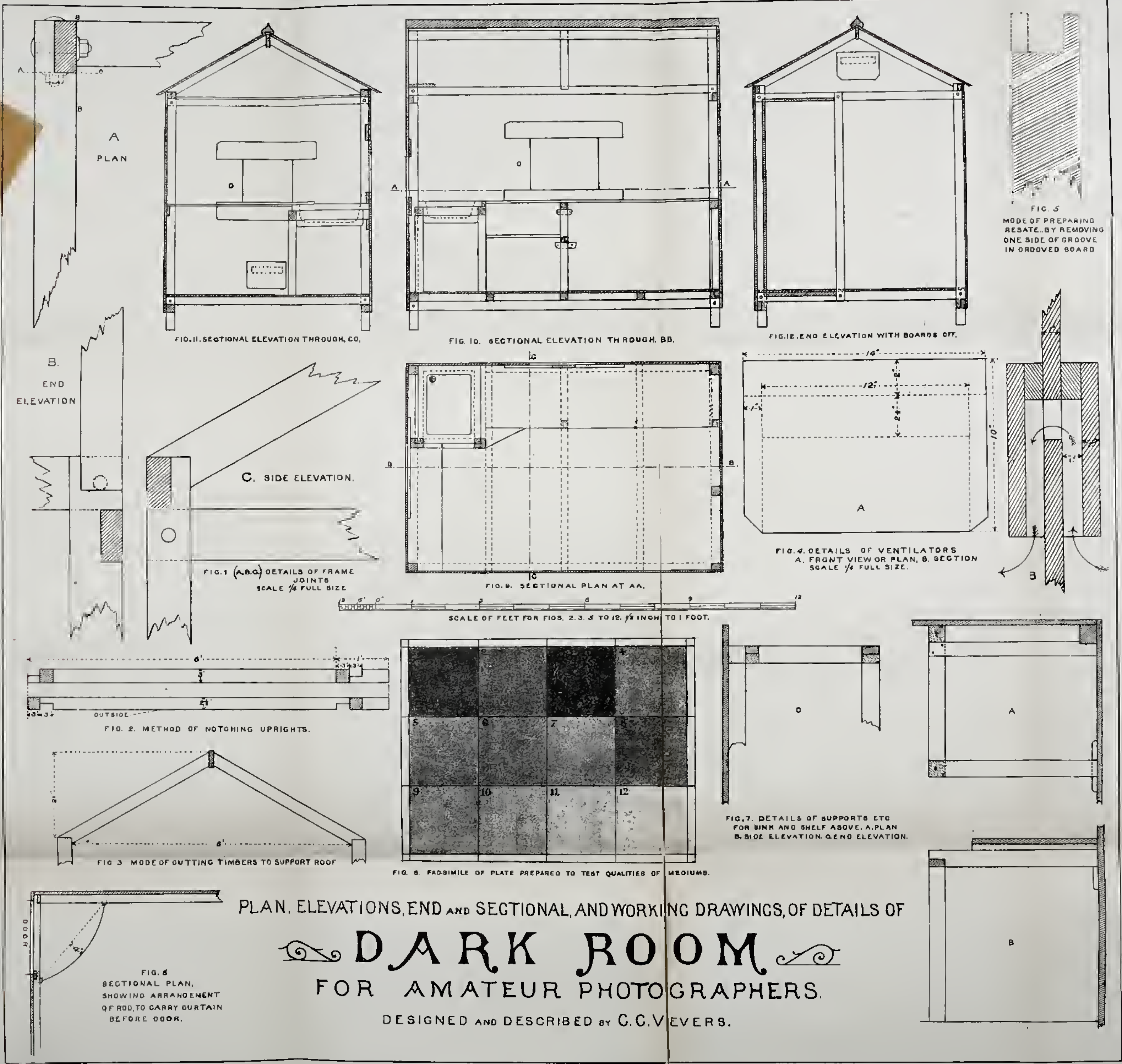
H. S. B. (*Dublin*) writes:—"Can any correspondent kindly inform me whether the '*Harrington*' *Clasp*, which was extensively advertised in the 'Graphic' last summer has been adapted to other uses besides gloves, and where it can be obtained? I am aware that Messrs. Dent have the exclusive right for gloves, but would be desirous of trying the clasp on boots in lieu of buttons, having for the last two months worn gloves fitted with it, and found it most satisfactory. Did you notice it among 'Novelties?' If so, I must have overlooked it, as I have AMATEUR WORK from the commencement." [No; I have not noticed it. Indeed, the clasp in question is not known to me.—ED.]

Loom for Fishing Nets.

BOX writes:—"I want to make some fishing nets. Will any reader kindly say how to construct a frame or loom such as are used at Musselburgh in the great manufactory there."

COMMUNICATIONS AWAITING REPLY

ROSELEA; SPAX; J. H. W.; J. S. (*Redditch*); HARPIST; T. B.; J. H. (*Romford*); E. C. R. (*Southwark*); T. M. B.; MAD JACK; G. L. G.; HONG KONG; W. F. S. (*Leicester*); BINGO; A. T. E. J.; GOLDSMITH; A. V. P. (*Islington*); A. W. W. (*Gateshead*); A. H. M. (*Newtownards*).


A PLAN
B. END ELEVATION
C. SIDE ELEVATION.
FIG. 1 (A.B.C.) DETAILS OF FRAME JOINTS SCALE 1/4 FULL SIZE
FIG. 11. SECTIONAL ELEVATION THROUGH, CO.
FIG. 10. SECTIONAL ELEVATION THROUGH, BB.
FIG. 12. END ELEVATION WITH BOARDS OFF.
FIG. 5 MODE OF PREPARING REBATE, BY REMOVING ONE SIDE OF GROOVE IN GROOVED BOARD
FIG. 9. SECTIONAL PLAN AT AA.
FIG. 4. DETAILS OF VENTILATORS A. FRONT VIEW OR PLAN, B. SECTION SCALE 1/4 FULL SIZE.
SCALE OF FEET FOR FIGS. 2, 3, 5 TO 12. 1/2 INCH TO 1 FOOT.
FIG. 2. METHOD OF NOTCHING UPRIGHTS.
OUTSIDE
FIG 3 MODE OF CUTTING TIMBERS TO SUPPORT ROOF
FIG. 6. FAC-SIMILE OF PLATE PREPARED TO TEST QUALITIES OF MEDIUMS.
FIG. 7. DETAILS OF SUPPORTS ETC FOR SINK AND SHELF ABOVE. A. PLAN B. SIDE ELEVATION. C. END ELEVATION.
DOOR
FIG. 8 SECTIONAL PLAN, SHOWING ARRANGEMENT OF ROD, TO CARRY CURTAIN BEFORE DOOR.
PLAN, ELEVATIONS, END AND SECTIONAL, AND WORKING DRAWINGS, OF DETAILS OF
DARK ROOM
FOR AMATEUR PHOTOGRAPHERS.
DESIGNED AND DESCRIBED BY C. C. VEVERS.

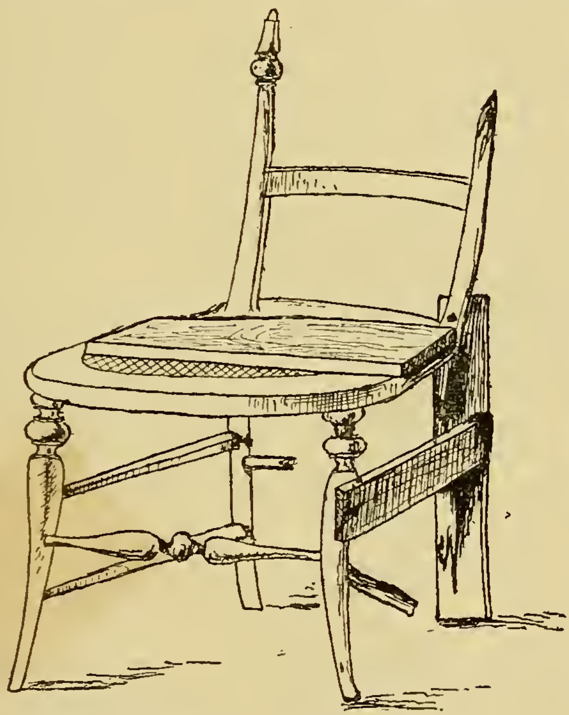
SOME HINTS ON CONJURING APPARATUS.

By D. B. ADAMSON.

II.—CONDENSED FOG—THE MAGIC BIRD-CAGE.

A FEW days ago, being in the neighbourhood where dwells the Professor already referred to in these papers, I determined to call on him to see if I might perchance learn some new thing for the benefit of readers of AMATEUR WORK. The Professor fortunately was at home, and at liberty to see me. With bated breath, as becomes an ordinary mortal who seeks an interview with wizards, editors, and such like inaccessible people, I enter and find the Professor in his atelier—that home of mystery in which he devises and constructs those wonderful "fakements" wherewith he delights to confuse the senses of the British public. After the usual greetings have been exchanged I am invited to take a seat by the Professor, who draws forward to the fire the representative of an easy chair which he keeps for the comfort of the select few whom he admits to his sanctum sanctorum.

Some readers may be curious to know what a modern wizard's den is like. I regret I cannot satisfy them by betraying its arcana, but I send to you, Mr. Editor, a sketch of the chair, from which an idea of the appointments of the room may be gathered. All are on an equal scale of luxury.*



EASY (?) CHAIR IN A CONJUROR'S WORKSHOP.
A Genre Picture by Mr. D. B. Adamson.

The Professor gracefully seats himself on his work bench, and appears lost in contemplation of the smoke arising from his cigarette. Not wishing to interrupt the meditations of such a great and learned man, I keep silent and smoke too. By and by, he jumps off his seat with an exclamation—his reverie seems to have been rudely interrupted. I ask him what the matter is, as, having noticed some tacks and needle points on the bench where he was sitting, I feared one of them had gone into him. He tells me, "There is nothing the matter, only a thought struck him." This appears to me quite a minor calamity, but I nevertheless assume an aspect of as deep sympathy as I can at such short notice, and express a hope that the thought had not struck him so hard as to hurt him much. He wishes to know if I mean to chaff him. Of course I assure him I would not venture to take such a liberty with a real live conjuror, and he is satisfied. Assuming an air of solemnity the venerable man discourses at great length. I will not weary you, dear reader, by repeating all he said; indeed, I do not remember all, or nearly all, but stripped of incomprehensible, and I fear inaccurate, classical and scientific references, his remarks were much as follows :—

"As you are aware, my researches are conducted with a view to the improvement of mankind. I am a public benefactor, though an ill-requited and unrecognized one; I do not assert myself sufficiently. True genius is retiring and shy. Now you know these are my chief characteristics." (I did not know anything of the sort, but did not like to say so.) "While watching the smoke from our cigarettes I have formed a plan for the total abolition of London fog. You know these fogs are caused by smoke remaining suspended in the atmosphere. Now, smoke is simply so much unconsumed carbon. I propose to collect this carbon, and thus not only keep the air pure, but render what is at present a waste product a valuable article of commerce. There is from our tobacco now enough smoke in this room to enable me to put in practice on a small scale my theory, and you shall watch my experiment."

Though without much faith in such a visionary

* I give the readers of AMATEUR WORK the full benefit of Mr. Adamson's sketch, as it may possibly prove helpful in showing amateurs who scorn perfect equality of surface for sitting purposes, to say nothing of cushions, how they may contrive to prolong the existence and usefulness of chairs which are sorely afflicted with rickets and in the last stage of decline.—ED.

scheme, and with a strong suspicion that the Professor is playing hankey pankey, I observe his movements. He fetches a tumbler, which he wipes inside with a damp rag wrapped round the end of a stick—he says, "to make sure that it is quite clean and free from any trace of whis—, I mean grease." He then pours a few drops of some liquid from what he calls a "crystal vial"—to my unsophisticated eyes it looks like a glass bottle—on to a handkerchief. He does this to render the fabric air-tight, I am told. He then covers the tumbler with the handkerchief, and makes wild dashes into the air with his hands, grasping, it seems to me, at nothing, which, when caught, he carefully places under the handkerchief. This appears very funny, so I ask what he is doing. He says, "Catching and condensing the smoke in the tumbler." He shortly lifts the handkerchief, and I see with surprise that the tumbler is full of a dense white smoke. I suspect a trick, and remind him that the carbon is still in the form of smoke. The explanation is that the thin smoke in the room is only partially condensed in the tumbler, but that further compression would have resulted in the production of solid carbon. Thus, concludes the Professor, will London be freed from fog. The scheme does not commend itself, and I offer to tell him the old fable of the mountain in labour. He does not want to hear it, as "it can't possibly have any reference to the demonstration which has just been made." Perhaps not; I, however, respectfully but firmly decline to take shares in a proposed company to be named the "Prevention and Abolition of Pea Soup Fog Company, Limited." My notion is that the Professor, instead of cleaning the tumbler, rubbed it with a rag moistened with muriatic acid. He certainly handled the rag very carefully, as if afraid it would burn his hands or clothes. The liquid poured on to the handkerchief no doubt was ammonia. Anyway, the mingled fumes of this and muriatic acid *do* form a dense white smoke just such as was in the tumbler, as anyone may prove for himself.

The Professor is by no means offended at my scepticism as to the success of his fog-clearing scheme, but converses with his usual affability and volubility, so that it is some time before I can explain the object of my visit. Several pieces of apparatus are shown me, but they are not quite what I want. One little box which has just been finished attracts my notice as being something fresh, and I take it up with a view to explaining its construction in these pages. I am informed that its object is to cause money to vanish with rapidity and without leaving any trace of its presence. The contrivance of such a box appears to me to be a misapplication of ingenuity, as I have never heard of anyone experiencing a difficulty in disposing of coin of the realm in the ordinary way, so I reject it as unsuitable. (N.B.—Conjurors generally *borrow* the money they want in the performance of their tricks, and perhaps are at times so overburdened with that useful commodity that a mechanical means of getting rid of it may occasionally be necessary to them.)

I suggest to the Professor that I should much prefer a box that would cause money to appear. This he has not got—not yet! If, however, I would like something that will produce not money but poultry, why, he had got the very thing. This seems better, so I examine one. It is a small square cage or box with wire door in front, and nothing inside but a perch. I make sure that it is otherwise empty, and hand it back to the Professor, who covers it with a handkerchief. This is promptly removed, when, behold! three or four canaries have somehow or other made their appearance inside the box. This will do; so as time is up, I arrange for a further interview with the Professor, whose explanation of the trick, with the necessary diagrams for the construction of the box, I hope to give in a future number of AMATEUR WORK.

In case any reader wishes to take lessons in conjuring, I can recommend Professor Enrique, 11, *Champion Terrace, Grove Lane, Camberwell, S.E.*, who is not only a conjuror, but also a maker of conjuring apparatus. As such he will be very useful to amateurs who wish assistance from a practical man.

(*To be continued.*)

THE REFLECTING TELESCOPE:

ITS CONSTRUCTION AND MANUFACTURE.

By EDWARD A. FRANCIS.

VI.—THE SPECULUM GRINDER'S WORKSHOP (*continued*)—ROUGH-GRINDING, TRUEING, AND FINING THE SPECULUM.

NOW that the actual working is reached, my readers will, in all probability, be astonished at its apparent simplicity. They will question perhaps why this present paper was not the first written. Let me hasten to assure them that when the grinding herein described is completed, the polishing yet remains, and that when the polishing is, in its turn also completed, then it is that their skill in and knowledge of practical optics will be found all too small to bring that final figuring, which is the consummation of speculum working to a successful issue. They may be sure, too, that even the grinding, being as it is tbe foundation of the finer working, is not so simple as it appears by description: and therefore was

it that this paper was not the first written—it would be almost useless without its predecessors.

This chapter may be appropriately opened with an explanation of the terms *short stroke* and *long stroke*. When short stroke is written, it is intended to indicate that the distance which the speculum traverses over the tool at each movement, is short, varying from one-eighth to one-third of their diameters. A reference to Fig. 10, page 56, will render this explanation clearer; the speculum is there shown in section, at the completion of a short stroke. By long stroke is meant any movement by which the speculum traverses from one-third to one-half of the tool. The completion of such a movement is illustrated in Fig. 17, page 57. In critical moments during the figuring it may be necessary to be more exact, but the general terms "long" and "short stroke" will otherwise be used.

The disc of glass which is to form the convex tool, and which shall be hereafter known only as the "tool," should be rigidly fastened by one of the previously described methods, to the bench, and fairly levelled. It is easier to level this disc while it is still flat than when it becomes the curved "tool;" and with ordinary care it can afterwards be removed and replaced as often as is desired, without seriously altering its truth in this respect. The metal face-plate may be cemented to the other glass disc—for the future the speculum—and it is advisable if the polish on the back surface of this glass is to be retained immaculate, that a piece of paper or linen should be cemented over it to protect it from the sand and emery, which will otherwise undoubtedly scratch it.

We are now prepared completely for the rough grinding. Place a handful of the moistened coarse sand or emery upon the tool, and taking up the position indicated by the sketch in the third paper of this series, begin working. With a speculum of the diameter selected, 6½ inches, the open hands will naturally fall into the attitude indicated in the sketch herewith, Fig. 33. This is a sketch of a workman's hands when they were actually in position, and it consequently presents them as seen by a second person. If, however, the reader will invert the page, the drawing is so arranged that it will then present such a view of the hands as would be seen by the workman himself. The constant rotation of the speculum is obtained by pushing the edge of the glass round with the lower part of the left hand, and pulling it with the upper part of the right hand. It will be seen that these parts of the hands overhang the edge of the speculum, it being of small size, and grasp it, so that the handle necessary, when a larger one is being worked, can be dispensed with.

This subject of the action of the hands, which action would vary more or less, according to the dimensions of the speculum, has been thus minutely entered into, because of its importance during the finer-working, and it is hoped that with the aid of the sketch, the reader will experience little difficulty in acquiring the habit, of giving, almost unconsciously, all the required movements to the speculum; for the mechanical part of the working becomes an almost automatic action after a short time.

The speculum should perform part of a rotation at each stroke. The stroke used in the first grinding is a straight one, simply moving the speculum to and from the worker, except that at the outset a few circular strokes may be given to more evenly spread the abrading material. Delicacy of movement is not specially required as yet, but a free and swinging delivery, so as to induce the sand to cut rapidly. The object of the working, the production of a hollow in the upper disc, should be continually borne in mind, and every stroke should tend to it. One should not, for example, raise the speculum each time the stroke is completed, but should keep it well depressed so that it may be the sooner hollowed out. Half stroke, as in Fig. 17, will be about the best for the purpose.

Very soon the sand grains will become pulverized, when both tool and speculum should be cleansed with a sponge, and a fresh supply of the sand obtained. The workman should continually walk round the bench during the whole process of grinding and polishing.*

At this first roughing out, no side stroke should be introduced or there may be a danger of the speculum being ground out of centre, to avoid which danger the centres of the speculum and tool should coincide at each stroke.

The term "wet" is a technical one applied to each fresh application of grinding material, and it will serve to remind the reader, that water is used during the whole process of speculum grinding and polishing. The sand or emery, when coarse, should be well soaked, and the superfluous water being poured away, any required degree of moisture—and the best degree will be soon ascertained by the worker—can be produced by using the saturated sponge as a reservoir from which water may be forced on to the tool. This only for the rough grinding: for the finer, the small "oil-can" mentioned in Paper 3 will be brought into requisition.

About three hours' constant work will suffice to rough out a 6½ inch speculum of 5 feet focal length,

* It may be mentioned here, that, if because of insufficient accommodation or of any other reason, it is found inconvenient to walk round the bench employed, the necessary purpose may be served by fastening the tool to a very heavy block, on a firm table, and frequently turning the block during the grinding and polishing of the speculum.

but the reader is advised to take it in stages; for assuredly roughing out a speculum by hand in this manner, though not particularly laborious, is so purely mechanical that to one of ordinary temperament, it becomes after the first hour positively irksome. Only the keenness of the pleasure and the feeling of power which one has in the final working, where mechanical labour is entirely subordinate to skill, fully atone for the monotony of the roughing out.

The progress of the grinding can be traced from time to time by the vertical application of the convex gauge to the concave speculum, or of the concave gauge to the convex tool. Vertical application is necessary, because if either of the gauges incline to one side or the other when testing, the curvature of the speculum, or of the tool cannot be accurately measured. The gauges should be applied exactly across the centre of the glass disc. When the speculum and gauge coincide, the rough grinding which will by that time have reached the edge of the glass, may be discontinued, and the tool, speculum, bench, and all that appertains thereto, scrupulously cleansed from the coarser grinding material.

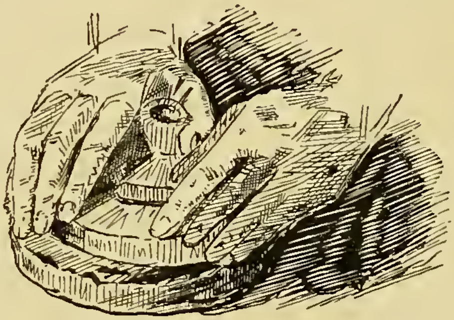


FIG. 33.—POSITION OF THE HANDS WHEN GRINDING THE SPECULUM.

The working just described is indeed a roughing out. Certainly it leaves us a nicely hollowed out speculum, but close examination reveals the fact that the glass surface is full of little pits and totally unreflective. It may appear somewhat paradoxical to speak of a *speculum* as *unreflective*; but my readers will remember that the word speculum is being used here, merely as a distinguishing term for the upper disc of glass. It shall now be our endeavour to work the concave surface we have obtained, to as true a spherical curve as possible, at the same time reducing these tiny pits until the glass is suitable for polishing.

For this purpose must first be used emery finer than the sand and afterwards flour emery; not touching yet the grades specially washed out for the fining.

"Trueing" shall be the title given to the next process, for it works the rough hewn concavity to a true curve. The fact of the speculum being hollowed out ensures correct centreing for the remainder of the working, so that side motion, which was shown in the last paper to be so necessary if we desire to obtain a spherical curve, may be safely introduced.

With the finer of the coarse emeries, or a very fine sand, continue working until all the marks of the first grinding are removed, they being entirely superseded by the smaller pits of this second grinding. The cleansing process must then be repeated, and the first stage of the trueing will be over. For this first trueing the stroke should be shortened to about one-third, so as to equalize the abrading action. It may be found necessary to shorten the stroke even more, so as to reduce the wear on the centre of the speculum, for the following reason.

When the first rough grinding is proceeding, the sole aim of the operator is to dig out the speculum to a certain definite curve. In order to do this rapidly and yet correctly, he abstains from using side stroke. The result is, that when the required curve is obtained, the action has been so concentrated on the centre of the speculum, that that portion is cut away slightly more than is necessary for an accurate curve, and this has to be allowed for in the earliest stage of the trueing. This defect is, I am inclined to believe, peculiar to Professor Thomson's method of working.

The irregularity can be easily seen by the amateur optician, if immediately the rough grinding is completed, he works for five or ten minutes with flour emery, after cleansing, and then holds the speculum obliquely to the light in the manner shown in Fig. 34. The part of the surface acted on by the emery will then appear to be semi-polished, while in contrast the centre upon which the fine emery has not acted, will remain roughened and unreflective.

The working with the second emery should be continued until by the use of short strokes and the introduction of side motion, the central depression, if any, has been corrected, and every pit of the roughing out has been removed. The grinding material must then be changed for flour emery, the specially washed emeries, be it remembered, are not yet to be touched. It should be constantly borne in mind that short strokes tend to lessen the curve, while long strokes deepen it, consequently if short strokes have to be continued for any length of time, it will be necessary to work afterwards for a period with long strokes again, in order to recover the original curve. This would only be necessary if any particular focal length is desired. When the flour emery is being used, very little will be required for each "wet," a quantity which could be carried on a farthing being more than sufficient. It should be uniformly moistened (with the aid of the before-mentioned oil-can) into a paste. Too much moisture is bad. The emery may be spread carefully

over the tool with the finger, wbich should immediately detect and remove any grit or large grains. Then with the bruiser (if one has been made) by a few circular strokes distribute the wetted emery evenly over the surface of the tool; on which the speculum should be tben centrally placed as in Fig. 18, page 57. Do not slide or draw it on. If the speculum be now pressed down close, it will secure any coarse grains, which have escaped the finger and the bruiser, being crushed before the work begins: thus no scratches will be made.

The grinding can now be proceeded with until the emery turns from brown to black, and becomes of a greasy consistency. It must then be no longer used, but removed by washing. The number of "wets" required of tbis flour emery depends upon the state of the surface after the rough grinding, but the trueing should be continued with one-third stroke, and a slight (about 1 inch) side stroke, until an evenly grained surface is obtained. A small magnifying glass may be conveniently used at this stage to examine the surface. It may now be ascertained by a more critical test than the application of the convex gauge, whetber tbe curve obtained is that required for a speculum of five feet focal length. Althougb practically a difference of a few incbes more or less would be of little consequence, it is as well to be precise in the measurement, and precision can be best secured on a bright sunshiny day—somewhat of a rarity at tbis season of the year in our unstable climate.

FIG. 34.—EXAMINING THE SPECULUM.

When the speculum is held towards the window, as pictured in Fig. 34, it presents a semi-polished surface, but when viewed directly, it will be seen that the polish is insufficient to reflect even direct sunlight to concentration; which it is required to do for this present purpose. So to give to the surface a false reflective power it should be wetted. If now the wetted speculum is placed so that its optical axis (see Fig. 3, Chapter I.) is pointing almost directly to the sun, it will reflect the rays back * until they meet at the focal point, in exactly the same manner that the reflector A B reflects the rays D E, in Fig. 3, page 8. It will be seen that we are reducing the theory of the first chapter to practice. The sunlight reflected from the speculum on to a paper or card will appear an irregular patch of light, larger or smaller as the speculum is moved to or from the paper. When this light patch (virtually an image of the sun) is smallest, the paper will be exactly in the focus of the speculum, and the distance between the centre of the latter and the paper is the true focal length.

A convenient method of making this measurement, is that of fixing the speculum in the proper position in the sunlight, and then placing a thin rod against the centre of it, receiving the reflected light rays upon a small piece of card sliding along the rod. The end of the rod which would touch the mirror should be padded, and the card must be moved along until the exact focus is found. It should be remembered that all parts of the surface of the speculum would separately reflect the light to the same focal point, and that, therefore, it is of no matter if part of the light is cut off by the paper or the rod used in testing.

If the focus be too great the second stage of the rough-grinding with long strokes must be again resorted to until the error be corrected; if, on the contrary, the focal length be too short, the worker may either prepare himself for the exercise of unlimited patience in the final figuring, or he may adjust the difference, perhaps, without resorting to rough grinding, by working the speculum and tool for a time in reversed positions, that is, the speculum

* Much in the same manner that the schoolboy throws with a piece of looking-glass the reflected sunlight on to the wall or ceiling, only in our case the reflected rays are converging to the focal point, while those reflected from the boy's mirror are parallel.

over the tool. This flattens out the curve, lengthening the focus. Only short (one-third or under) strokes should be used for this correction.

Neither of these faults having been discovered, or when being discovered they have been amended, the "fining" may be proceeded with.

The "fining" merely consists of the proper use of the specially elutriated emeries. Referring to Paper 4, it will be assumed that Dr. Draper's table of grades, with the addition of a "sixty minute" emery, has been adopted. Take first the "three second" grade, which is the coarsest, and placing a portion upon the tool, work it in every respect similarly to the manner in which the flour emery was worked in "trueing." Repeat the "wet" three or four times with the same emery, working each "wet" for about fifteen minutes. By that time the grain left on the surface by the flour emery will have given way to that of the "three second" grade. Owing to the fact that this latter emery merely consists of the coarsest grains of the flour emery, the difference in the surface will be so slight as to be practically unnoticeable.

The grade next finer should now be applied in a similar manner three or four times, and then the speculum and tool having been thoroughly cleansed, working should be continued with the same precautions until the finest or "sixty minute" emery has been reached. Of this as of the others of these elutriated emeries, only the smallest quantity will be required for each "wet." It is a good plan to work the emeries of the last three grades for fifteen minutes, and then instead of cleaning off at once, wash the tool only, leaving it wet, and without applying fresh emery, work on for a few minutes with that which remains adhering to the speculum: this adds to the ultimate fineness of the grain given to the glass surface.

Apropos of washing the speculum and tool, it may be mentioned that there is no necessity at any time during the grinding to dry them, only wipe them perfectly clean with a damp sponge. Do not *lift* the speculum off the tool when the grinding is nearing perfection, that is, during the trueing and fining. Such a proceeding is liable to cause the edge of the speculum to chip by reason of the adhesion of it to the tool. The proper method is to slide the speculum off with the right hand, placing the left hand underneath the glass to support it, and not lifting at all until it is completely freed from the tool.

If any of the emery is worked too fine or too dry, the speculum is liable to adhere firmly to the tool. Should such an accident occur during the grinding, do not attempt to part the glasses by force, but simply plunge them in water, allowing them to remain there until they can be easily separated. The speculum should not be left unguarded upon the tool, for it may slide off on to the bench and be damaged. At the end of the trueing the pressure of the hands should relax, merely grasping the speculum so as to have it completely under control, and during the remainder of the working no pressure is needed.

The amount of care which is required during this "fining" cannot be over-estimated. Upon the manner of its accomplishment it depends, whether the polishing can be at once proceeded with or whether one of the earlier stages of grinding must be returned to, for the purpose of correcting some error. If the instructions have been intelligently followed, the glass surface produced should be one that has been aptly described as "exquisitely fine," and "semi-transparent" "appearing as if covered with a thin film of milk." Viewed obliquely, as in Fig. 34, the surface should appear beautifully polished. Moreover, the concavity will be almost spherical.

How to remove the film and polish the glass to perfect limpidity, it shall by my duty to instruct the reader in a future chapter.

(*To be continued.*)

THE ART OF PAINTING ON THE PHOTOGRAPHIC IMAGE.

By JOSEPH HARRIS.

VII.—DRAPERIES AND ACCESSORIES.

WHAT a striking similarity there exists in the accessories which almost invariably accompany the photographic portrait. There is the same chair, the same table, with its very inappropriate table-cover, the same ferns growing out from the top of a pedestal, the same extraordinary combination of form in pasteboard which does duty for a rock to the photographer in search of the picturesque, but which aforesaid photographer appears singularly destitute or uncertain of the means whereby the best to secure his aim.

And this similarity of accessory or aid to pictorial effect is by no means confined to the photographs of English productions. Frenchman and Russian, German and New Yorker alike seem imbued with the idea that the most natural thing for an individual to do when he or she requires a portrait is to make as rapidly as possible for the table, the chair, the rock, or the fern, and then—touch it with one hand! The remaining digital member—what a mercy for the photographer, the sitter possesses no more than *two* hands to be posed—the remaining digital member invariably dangles by the side of the body in the limpest of forms, as if in bewilderment at its unobtrusive position, and evidently desirous to share in the prominence possessed by the hand which is holding the back of the chair.

The colourist may well despair as he studies this "Art Photograph," preparatory to deciding on his means for effect. His desire is to paint a portrait with effective drapery and accessory, and unto him is given a page which might do good service for an advertising upholsterer, so pronounced is the carved oak chair back and the texture of the intruding table-cover. Possibly, some of the curtains and pedestals and miscellaneous furniture may be obliterated by a judicious application of body colour, and there may yet be a slight chance of restoring the portrait to the first principles of Art. But, unfortunately, in too many instances there is that hand—only one of them, it is true—and that one wildly grasping the rock as if to prevent that rock, for very shame's sake, from running out of the picture. In this case there is no help for it, and the "composition" must be adhered to. Only the colours may be subdued, the chair with the carved elaborations can be thrown in shadow, the ferns may put on the most sober of autumnal tints, the rock may be lightly washed, touching here and there one or two salient points in opaque colour for relief, as the light is supposed to fall on them.

In a properly composed picture the hands should be off the accessories, which will keep their places very well indeed without being held down; a glimpse of chair or other article of furniture may be faintly indicated at the lower portion of the photograph, blending this indication with the darker part of the background. The fewer details in the matter of accessories, the better is the composition artistically; and when the whole picture be finished, study it carefully, and paint out as much detail as can be dispensed with, and a vast gain will be the result. Let everything be subordinate to the figure, and let the whole be a careful and painstaking blending of appropriate contrast, so as to form a pleasing and effective harmony.

Draperies are best put in with transparent colour, as the photograph will reproduce the folds of the dress with perfect accuracy. Sometimes the effect may be improved by opaque colour on the lights, always remembering to keep the folds as square as possible, so giving firmness and solidity to them. The shadows may be strengthened by local colour mixed with pure water.

A good black is made with brown (or black) indigo and crimson lake. For blue, take cobalt and a little Chinese white, shading with French blue, or indigo and crimson lake. Purple may be made with cobalt and crimson lake and Chinese white, at choice, to make the colour lay evenly. Never paint the draperies so brightly that they interfere with the face: in a properly coloured picture, it is the head which must first attract the attention of the spectator; the dress, by its harmonious contrast, must be but auxiliary to the character of the subject.

By aid of the remarks which have been from time to time given in this work, it is to be hoped that many amateurs possessing artistic taste have been enabled to turn some of their photographs into truthful pictures. To this one, such an occupation is a pleasurable pastime, to that one a source of profitable employment; but, whether pursued for pleasure or for gain, the occupation must tend to that development of natural ability, and to that elevation of mental faculty which enables each one of us the better to appreciate the glorious works of Nature. To the artist amateur who would aim at perfection, let this be the strict injunction given, and the following of it will bring its own reward. For all in the shape of accessory required, go to Nature, and study there. Does your photograph represent happy childhood amidst the flowers? Hie to the nearest wood, to the neglected common, and reproduce some lines from the tangled thicket or the sun-burned gorse; one or two skilful touches will redeem the photograph from the commonplace, and will impart an originality and a freshness to what was before but artificial.

In a future Part of this Magazine I hope to give some explicit instruction on the art of producing Vitrified Photographs. Many amateurs are often deterred from the practice of this the most beautiful of all branches of photography, by mysterious hints of difficulties and impossibilities. In these days we do not recognize the impossible; and difficulty, if it exist, but adds to the pursuit of pleasure.

HOW I FURNISHED MY HALL.

By MARK MALLETT.

II.—MY HALL SEATS—MY SETTLE—MY STOOLS.

MY HALL SEATS.—To the question of how I might best supply my small hall with sitting accommodation, I gave some serious consideration. I reflected that though something of the kind is usual and desirable, luxurious chairs are scarcely wanted in such a situation. No one wants to sit on a hall seat, unless it may be a waiting errand boy, who is not critical in such matters; and more frequently its office is to furnish a convenient resting-place for a bag or parcel. I concluded, that instead of chairs, something of the nature of the old-fashioned settle would be better for my purpose. Such an article could be made to occupy less space as regards breadth than chairs. In my peculiar style of carpentry it might be readily and strongly made; and it need not necessarily be unsightly. The result

was, that I planned the seat shown in front elevation in Fig. 7.

I proposed that my seat should be long enough to accommodate two persons, if required, and made its length, including the uprights, 3 feet 6 inches. Its greatest projection from the wall is 13 inches only. The height of the seat is 18 inches. Perhaps the elevations hardly give an adequate idea of the appearance of the article, but a perspective view of it would have taken up space unnecessarily, and these illustrations will serve to show that whilst most simple in its construction, it is sufficiently strong to bear much rough usage; indeed, apart from our present purpose, its construction may furnish hints for the building of garden seats.

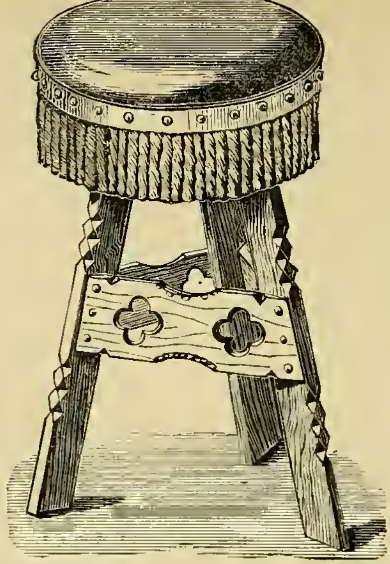


FIG. 11.—STOOL FOR HALL—PERSPECTIVE VIEW.

For the ends, one of which is shown in elevation in Fig. 8, I made use of 1½ inch board 11 inches wide. Each piece was 2 feet 6 inches long, but owing to the sloping form of the top, a 4 feet 6 inch length cut the two. At A A in the above figure are shown two mortises, their tops 18 inches from the floor line, which are 2½ inches broad by ¾ of an inch deep; these are to receive the tenons of the seat-board, as shown in Fig. 9. B, Fig. 8, shows where an opening is sawn to admit the end of back rail G, Fig. 7, and C shows a similar opening to the front for the end of strip F, Fig. 7, which supports the front of the seat-board. It will be seen that the bottom of the upright is slightly hollowed out—that is, that it may stand more firmly, and in the curve hollowed out from the front of the upright at D, I used a form of simple ornament somewhat different from any before employed, and which is drawn on a larger scale in Fig. 10. It is made by first rounding off the edge of the wood-work, after which each ball and the hollows leading to it on either side, are formed by four strokes of the mallet and gouge. It makes a pretty enrichment at a very slight cost in labour. It will be seen to be carried through most of the ornamental hollows in this piece of furniture.

In the front elevation, Fig. 7, the edge of the seatboard is seen at E. This board is ¾ of an inch thick, and 1 foot wide. From upright to upright it measures 3 feet 3 inches, but the tenons at each end cut into an additional 3 inches of stuff, and demand a total length of 3 feet 9 inches. These tenons project 1½ inches beyond the uprights at each end, and are there secured by pegs. Fig. 9 shows on a larger (2 inch) scale, the manner in which the ends of the seatboard are cut and secured. It will be seen that this board projects an inch before the uprights, and that in addition to the tenons and pegs, it is secured to their front edges by a couple of round-headed screws. Its upper front edge is rounded off as shown.

Below this board, and supporting its front, is a strip of ¾ inch wood, 1½ inches wide, F, Fig. 7. The ends of this strip are let into the front edges of the uprights and come flush with them, as shown at C, Fig. 8. It is secured to the uprights by a round-headed screw at each end, and also by 2-inch screws passing upwards from below into the seat-board. Of the three small pieces seen beneath this strip, that at the centre is for ornament merely; the two spandrels at the ends being screwed into both strip and upright, serve also to give additional strength.

The back-rail G, Fig. 7, is of ¾-inch wood, 3 inches wide, and 3 feet 6 inches long. Its

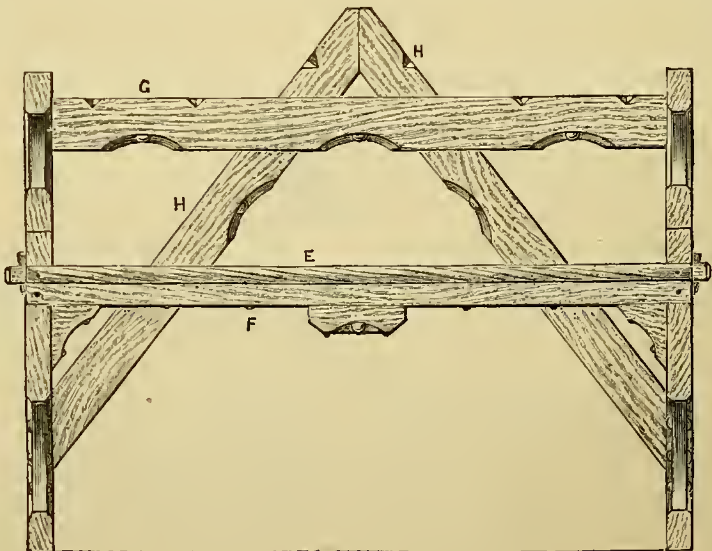


FIG. 7.—HALL SEAT OR SETTLE—FRONT ELEVATION.

ends are let into and are flush with the back edges of uprights, as shown at B, Fig. 8. A couple of flat-headed screws at each end fix this rail in place.

At the back of the whole seat, binding it together, and giving to it as much strength as can be desired, are the two diagonal braces H, H, Fig. 7, which are also indicated by the dotted lines at I, Fig. 8. These are of inch wood, 3 inches wide and 3 feet 3 inches long, and are strongly screwed with flat-headed screws from behind into the uprights, the back edge of the seat-board, and the back rail; they are also fixed together by a couple of screws where they meet at top.

The two more important illustrations of this seat, Figs. 7 and 8, are drawn 1 inch to the foot; Fig. 9 is 2 inches to the foot; Fig. 10 is not drawn to scale.

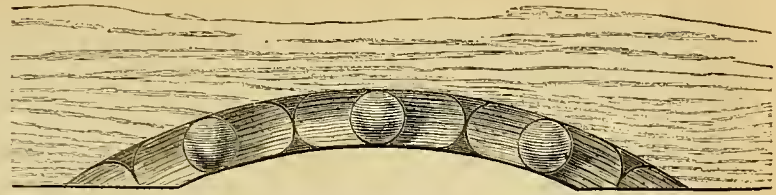


FIG. 10.—ENRICHMENT IN HOLLOWS OF HALL SEAT.

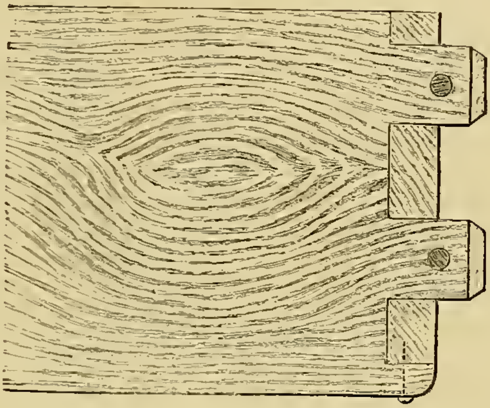


FIG. 9.—END OF SEAT-BOARD SHOWING TENONS OF PEGS.

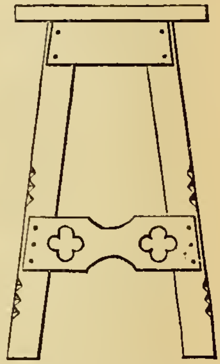
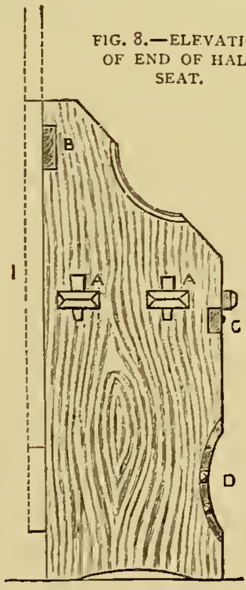


FIG. 12.—ELEVATION OF STOOL BEFORE COVERING.

The above piece of furniture appeared to me very sufficient for its purpose. I looked upon the plain wooden seat and back as being desirable in the interests of cleanliness, and not unsightly. But a time was at hand when a voice of greater authority than my own in household matters, was to make itself heard in the house; and I was then told that my settle looked cold and bare, and that something must be put in its place with more upholstery and colour about it. My business was only to obey. My settle was relegated to a distant part of the house, and instead of it, I made two stools, one to stand on each side of my table. These stools, of which a perspective sketch appears in Fig. 11, were (to please the feminine taste now in power) stuffed and covered with plush, and adorned with a heavy woollen fringe of an æsthetic colour. I must admit that they had a warmer and more finished appearance, but they by no means afforded such handy places in which to set down a parcel, as did my discarded settle.

The perspective drawing already mentioned is not made to scale, but in Fig. 12 the dimensions are indicated 1 inch to the foot. This diagram is intended to show the construction of the upper part which is in Fig. 11 hidden by

FIG. 8.—ELEVATION OF END OF HALL SEAT.



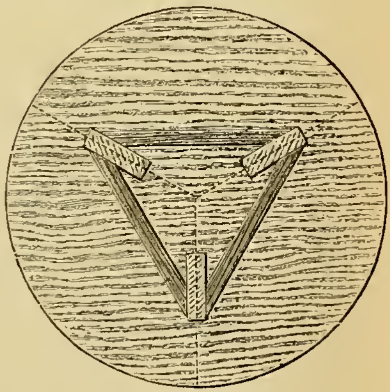


FIG. 14.—TOP OF STOOL.


FIG. 15.—CROSS-PIECE OF STOOL.

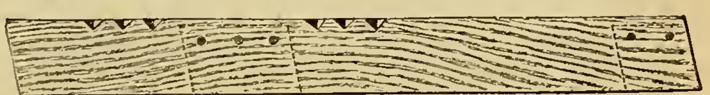


FIG. 10.—LEG OF STOOL.

the covering and fringe. Simple as this stool really is, I find that those who have tried to imitate it have found difficulties in the way of putting it together, and I shall therefore explain my method of making it, step by step.

In the first place, I cut out my three strips to form the legs, as shown in Fig. 13. These were of $\frac{3}{4}$ inch wood and $2\frac{1}{4}$ inches wide. I enriched their outer edges with a little simple notched ornament, and the dotted lines in the diagram show where the ends of the cross-pieces were afterwards set against and screwed down to them.

To cut a circular piece of board of the same thickness, and 12 inches in diameter, was my next work. This was to form the top, and its under side is shown in Fig. 14. The manner in which the tops of the legs and the upper cross-pieces are arranged against it is there seen.

To determine the positions of the leg-tops against this board, I divided the circle into three equal parts, and from these divisions I drew lines to the centre. I then marked the space to be occupied in each line by the leg, placing the outer edge of each leg four inches from the centre. With a temporary brad or screw I then attached each leg to its assigned place, leaving the lower ends to straggle at their will.

To bring these last into proper discipline, I drew upon the floor of my workshop the larger circle which they were intended to occupy—one, that is, with a radius of about seven inches. This, in like manner, I divided into three equal parts, and drew my three radii as before. On these, and touching the circumference with their outer edges, I placed the bottoms of the legs and fixed them in a temporary way, but pretty firmly, to the floor, with a brad or two. Having done this, I proceeded to fix down the top board in its place more securely.

The skeleton of my stool being thus secured in position, I could fit and try the cross-pieces upon it at leisure. This was a matter of importance, since as there are *no right angles* in these cross-pieces, it would otherwise be impossible to cut them so as to fit with accuracy. And first, I shaped the lower cross-pieces, of which the details are given in Fig. 15. These are of $\frac{1}{2}$ inch wood, $3\frac{1}{2}$ inches wide and $11\frac{1}{2}$ inches long. They are fixed in place with small round-headed screws.

The upper cross-pieces are of the same thickness, but only $2\frac{1}{2}$ inches wide and 8 inches long. As these would afterwards be wholly hidden by the fringe, I fixed them with flat-headed screws to the legs, and also to the top-board to which they were firmly fixed by screws passing downwards.

After this I had only to stuff and cover the top—an operation requiring some neatness of hand, and to fix on the deep fringe with brass studs. The diagrams which refer to this stool are all drawn to a 2 inch scale, except Fig. 12, which is 1 inch, and Fig. 11, which is not drawn to scale.

(*To be continued.*)

DRY-PLATE PHOTOGRAPHY:

THE GELATINO-BROMIDE PROCESS.

By C. C. VEVERS.

(*For Illustrations see the Folding Sheet issued with this Part.*)

II.—THE DARK ROOM: ITS CONSTRUCTION AND APPURTENANCES.

BEFORE commencing this article, I wish it to be plainly understood that I am writing for those who have little or no knowledge of Chemistry, and practically *none* of Photography. My first thought is for the beginner, and not for the experienced amateur, who, I hope, will overlook the "twaddle," as he will term any rudimentary instructions he may hereafter come across. I repeat, I am writing, in the first instance for the tyro, consequently, I must explain everything that might tend to confuse him, otherwise the worthy novice would speedily be lost in a sea of technical terms, and eventually give up his study of the art in despair. Nevertheless, I shall endeavour to make my work as interesting and instructive for his more advanced brother amateur, as my feeble expository powers and the science of photography, will admit. Again, I do not advocate what is known as "rule-of-thumb-work," and while teaching the practical part of the work as simply as possible, I shall endeavour to propound a slight smattering of the theory of the work he undertakes to the beginner.

The workroom, in which most of the operations will have to be conducted, must first occupy our attention.

Most workshops, laboratories, etc., are built with a view for convenience in any special class of work for which they are intended; the construction of the photographic workroom must also be peculiar to the art. It is necessary, for the successful management of gelatine plates, that it is entirely free from *white* light, dust, and damp—the three great enemies of photography. But it is not inevitable that the room, devoid of white light, should, consequently, be *dark*. Dark it must be, in a chemical or photographic sense—the light entering the room must be *dark* to the sensitive salts on the plate, though it need not be dark to the eye of the operator. Most of my readers will know that white light (rays of light from the sun: daylight) is composed of various colours. If a ray of light were passed through a glass prism, it would

be decomposed and divided into all the colours of the rainbow, which would be shown on a sheet of white paper in the following order :—Red, orange, yellow, green, blue, indigo, and violet. Of these red, yellow, and blue are the three primary colours, the others being combinations of them. Each of these have an individual power ; thus, the red has the heating, the yellow the illuminating, and the blue the chemical property. The blue and its kindred rays, then, it is that act on the sensitive film (the chemical change which takes place, I shall describe in a future paper), while red and yellow light have no effect whatever on the sensitive salt. The chemical ray of the spectrum (blue) is termed in photography the *actinic* light, while the heating and illuminating rays are called *non-actinic.* To enable a plate, sensitive to blue light to be manipulated with safety, all the blue rays contained in the white light must be rigidly excluded from the room. To do this we must filter the white light through some non-actinic medium, such as red, ruby, or yellow glass, yellow paper, etc. This room has, since the days of Daguerre, been called the "*dark room*," a name certainly erroneous and misleading, which probably originated in the Daguerreotypian period, when the rooms *were* dark, much, I should think, to the operator's inconvenience and discomfort. The word "dark" is the cause of many beginners working in a room where they can scarcely see a foot—or, more correctly speaking, a hand—before them. This is altogether wrong ; the room should be well and plentifully lighted, and, if the proper media are employed, sufficient light may be admitted to see comfortably all over the room, and still be perfectly safe for the manipulation of the most sensitive plates.

If it be the amateur's intention to use an existing room as his dark room, it must (1) be large enough for him to move about in it with freedom and ease—a stuffy cupboard or closet will *not* do, although most beginners think so ; (2) it must be perfectly light-tight as regards the blue rays of the spectrum : when the door is shut, not a particle of white light must be allowed to gain an entrance ; (3) it must be well illuminated with *non-actinic* light : either daylight or artificial light may be used, or both ; (4) it must be well ventilated, free from dust and damp ; and there should also be (5) water and gas connection. A good-sized bench or table, and one or more shelves for the chemicals are also necessary.

The room should certainly not be smaller than 6 ft. by 4 ft.; I have found one measuring about 9 ft by 6 ft. a very convenient size. I shall describe the construction of such a building—one that can be fixed up in any out-of-the-way corner, and taken down again, if necessary, in a few hours.

It is of course made of wood, and can be utilised for many other purposes besides photography. For instance, it makes a good bicycle-house, amateur's workshop, "bachelor's retreat," and can be put to a variety of other purposes to which the amateur can apply it. Those who do not wish to go to the expense of building such a dark room will obtain sufficient hints from the following directions for fitting up some unused attic, bedroom, outhouse, or workshop ; but I should certainly advise those amateurs who have the space, and can afford it, to have such a place put up. By following my directions, anyone who can turn his hand to a little joinery, should, with the assistance of a friend or labourer, be able to build one for considerably *less than* £5. In this room all the photographic operations can be conducted : from coating the plate with emulsion, to mounting and burnishing the print, excepting, of course, taking the photograph. As a further guide to the "amateur builder," I will, as near as it is possible, give the estimates of the materials to be employed.

The materials required are as follows :—

	£	s.	d.
30½ square yards 5 inch by 1 inch boards at 1s. ...	1	10	6
8¼ ditto 6 inch by ¾ inch boards at 11d. ...	0	7	7
2 ditto 11 inch by 1 inch boards at 1s. ...	0	2	0
½ ditto 9 inch by 1 inch board (for shelf)...	0	0	6
154 feet timbers, 3 inch by 2½ inch at 1d.	0	12	10
18 half-inch bolts 4 inches long	0	1	6
10 lbs. two-inch nails at 2d.	0	1	8
Latch lock for door	0	3	0
Hinges for ditto	0	0	4
Glass for windows...	0	2	6
Papers for ditto	0	0	10
Felt for roof, 10 yards at 6d.	0	5	0
Zinc nails for ditto, 3 lbs. at 6d.	0	1	6
Ridge roll for ditto	0	2	0
Sink (24 inches by 18 inches)	0	4	0
Brass water-cock for ditto	0	2	0
Gas burner and tubing	0	3	0
1 ply "Willesden" paper for walls, etc., 12 yds. at 5d.	0	5	0
Material, rings, iron rod, etc., for curtain	0	4	6
Total cost	£4	10	3

Do not buy the boards, spars, etc., from a joiner, but go direct to the woodyard for them, thus saving the former gentleman's profits. When ordering the boards, have them cut to the following lengths ; this the timber merchant will do without any extra charge, and it will save you considerable trouble afterwards :—

For the two sides ...	22 boards	13 feet long	5 inch wide.
,, two ends ...	15 ,,	15 ,,	5 ,,
,, floor	8 ,,	18 ,,	5 ,,
,, roof	8 ,,	18 ft. 6 in.	6 ,,

All the above must be tongued and grooved, and should be well weathered for a week or two before using.

For the benches	...	1 board 14 feet long 11 inches wide.	
Ditto	...	ditto 8 ft. 9 in. ,, 11 ,,	
For the shelf	...	ditto 6 feet ,, 9 ,,	

The timbers should be obtained cut :—

4 spars 7 feet long	1 spar 21 feet long.
8 ,, 6 ,,	4 ,, 9 ,,
3 ,, 7 ,,	

The bolts should be what are termed "cup-headed," and supplied with nut and washer.

Having decided on a suitable situation for the structure, and the ground having been levelled, the amateur joiner proceeds to put the framework together.

The uprights for the four corners of the building must first be cut to shape. Four 7 feet spars will be required ; they must be notched half through for the reception of the horizontal timbers as shown in the details in the Folding Sheet in Fig. 1, A being the plan, B the side elevation, and C the end elevation, and in Fig. 2, which shows details of mode of notching uprights, care being observed that all joints shall face outside, when the framework is put together.

Now the four pieces, each 9 feet long, are cut to fit into uprights and bolted together, which will then give the framework of the sides. Four of the spars, 6 feet long, must be mortised in the same manner, and bolted as before for the ends of the building.

The skeleton of building, so far completed, should now be levelled, and fixed on four stones, or tiers of bricks cemented together, a few inches above the ground to allow air to pass underneath, thus preserving the floor boards from rotting prematurely.

The timbers to support roof must next be cut and fastened, as shown in details in Fig. 3. To obtain the desired angle, make a full-sized sketch on the ground, or any convenient spot, with a piece of chalk, giving the roof a fall of about 21 inches ; thus :

Two of these must be fastened at each end of the building to the uprights, and another pair exactly in the centre to the cross spars, as shown in Fig. 10.

The sides can now be boarded up, great care being taken that the boards are fitted close up, so that no light can pass between. The 5 inch boards are not so liable to warp, I find, as wider ones, and although they may take a little more time nailing on, they will be much more light-tight, and present a smarter appearance than wider boards.

The ends follow. A spar must first be bolted to the cross pieces at one end (as shown in the End View, Fig. 11), on which to swing the door, which, for convenience, should be made to open outwards. The opening for the door should be fully 2 feet wide. Fifteen boards 15 feet long will, if cut with judgment, just suffice for the ends ; they are nailed on as at sides, and must reach within an inch of the inside of door frame. The door itself should be fastened together with two or more *strong* boards, which, of course, when the door is hung, must be on the inside. The door is hung on two strong hinges, and should be supplied with a good latch lock (which, of necessity, will be what is known as "left-handed") and a handle to close the door from the inside.

The floor is next put down. Three spars, 6 feet long, are laid latitudinally across the bottom and nailed firmly to the timbers forming the sides of the building, thus leaving a space of 2 feet between each. On to these timbers the floor boards are nailed ; they must be fixed as close as possible to the boards at the sides and ends.

Now for the ventilators, Fig. 4. Little need be said of these, as by a careful reference to the details on Folding Sheet the builder should be able to construct them without any difficulty. With a keyhole saw an opening is cut out of the boards at each end, as shown in working drawings, 12 inches by 2½ inches. If the building is in a confined situation it is advisable to make these openings larger—say, 18 or 20 inches long, as there must be a thorough flow of pure air through the building, or the amateur photographer's work will be beset with innumerable difficulties. Over the opening—both outside and inside—a strip of wood, 1 inch by 2 inches, is nailed ; pieces of wood, 10 inches by 1 inch are also fastened at each end of the opening. On to this frame is nailed or screwed a board, 14 inches by 10 inches. (See details on Folding Sheet. In Fig. 4 the dotted lines in A represent the strips of wood forming the frame round the opening, while B shows the ventilator in section.)

The roof boards are now fixed. These I laid longitudinally along the building, but if the amateur can spare the extra time expended, they will be more water-tight nailed on the other way. Whichever plan is adopted, the boards should hang over the sides and ends a few inches, so as to allow the water to drop off without running down the boards.

We should now have got a veritable "dark room." Step inside and shut the door ; should a most careful critique disclose any chink or knot-hole that will admit the smallest spark of light, it must be carefully stopped up with putty or whitelead. Round the edges of the door, light will probably gain an entrance, as much of this as possible must be stopped out ; what remains can be shut out by the aid of a curtain, which I shall describe shortly.

The amateur must now turn glazier, and fix in his windows. The one at the side is in the centre of the boards, and the bottom is to be three feet from the floor. The size of the window itself (which is ordinary white window glass) is 24 inches by 18 inches. Take the pane, hold it against the boards in the place the window is intended to be, see that the top

and sides of the glass are parallel with the cross pieces and uprights of the building, and run a pencil round it, marking the exact size of the glass on the boards. Cut the boards away with the keyhole saw, taking care to cut slightly at the inside of the pencil line—if the opening thus made be too small for the glass, a shaving can easily be cut away with a chisel, but if it is too large the only remedy is to have another glass cut to fit. The square must be firmly secured with strong "sprigs" and plenty of putty. Over and below the window a strong board must be nailed, extending several inches at either side, to support the boards cut short. These boards should have a rebate fully $\frac{3}{4}$ inch cut along one edge, which edge must be fastened nearest the window. To make these rebates I took a grooved inch board and simply cut off one half of the groove, shown by dotted lines in Fig. 5. The *width* of the boards, I may say, is immaterial. Into these grooves can be slid one or more frames covered with some non-actinic material, or if it be desirable to make the room absolutely dark, a blank square of stout millboard may be inserted.

The position of the other window, it will be perceived, is in the end opposite the door; under this window most of the operations requiring strictly non-actinic light—such as developing the latent image on the sensitive plate—will be conducted; it is, therefore, advisable that this window should be permanently glazed with non-actinic glass. The bottom of the window should be placed almost level with the bench on which the dishes containing the various chemicals will be placed, it being indispensable that there should be a good light thrown directly on to the dish containing the plate and developer. It is not necessary, however, that this window should be as large as the one at the side of the building. I find one measuring 18 inches by 15 inches will transmit ample illumination for all minor operations, and, when more light is needed, the larger window can be brought into requisition and used, alone, or in conjunction with the smaller. The window is marked and cut as before, horizontally—in the middle of the boards, and the bottom 2 ft. 9 in. from the floor.

A few years ago, nothing but deep ruby glass was used in the illumination of the dark room, all the lighter shades being accounted as unsafe. It has since been discovered, by extensive experiments, that although retarding the entrance of light to a much greater degree, and consequently making the room much darker than when *yellow* glass is used as a medium, and at the same time the light transmitted through the ruby glass being *much* more injurious to the eye-sight of the operator, it is not a whit more non-actinic. This I have also found to be the case by personal experiment.

The best deep yellow glass should be used, and can be obtained from almost any glass warehouse; for the above size the price should be about 1s. 6d. It is fixed in a similar manner to the preceding window, and the cross-pieces to support the wall boards are also cut with a groove as before.

Whilst on the subject of windows, I may as well conclude with a few remarks on the best illumination for the dark room. Much has been written and said, of late years, respecting *green* tissue, in combination with some other medium, as a safe and pleasant medium for the dark room. Determined on testing the relative qualities of this and other media—separately and in *combinations*—I recently devoted several hours to practical experiment with this object in view. For the benefit of those readers who may wish to test the non-actinic power of any medium or media, I will detail my mode of progression. Armed with a rule, pencil, a large sheet of black opaque paper, and one of the most sensitive plates the market can produce, I illuminated—or, rather, *darkened*—my dark room with a light I knew would be absolutely "safe" for almost any length of time. I then took a plate (known as $\frac{1}{4}$ size—$4\frac{1}{4}$ by $3\frac{1}{4}$ inches) out of the package, and, with pencil and rule, divided it into 12 square inches; these squares I marked from 1 to 12 consecutively. In the centre of the black paper I cut a hole 1 inch square: the size of one of the squares on the plate. Having placed the paper with the hole exactly over square No. 1 on the plate, and having placed the lot within a few inches of the window, I removed all the sliding frames and exposed the plate, or rather $\frac{1}{12}$ of it, to *white* light for exactly 10 minutes. I then blocked up the window, moved the square hole in the paper over square No. 2 on the plate, covering the whole, until I had fixed the slide covered with pale yellow tissue paper before the window; I then exposed for the same length of time through this medium. At the end of 10 minutes I moved the paper on to square No. 3, and exposed through green tissue. Altogether I exposed, for 10 minutes each time, the 12 squares on the plate, as follows:—

No. of square on plate.	Medium.		
1.—	Daylight.		
2.—	Yellow tissue.		
3.—	Green ditto.		
4.—	Canary medium.		
5.—	Yellow glass.		
6.—	Combination	of green and yellow tissues.	
7.—	Ditto	ditto	canary medium.
8.—	Ditto	ditto	yellow glass.
9.—	Ditto	yellow	ditto.
10.—	Ditto	ditto	canary medium.
11.—	Ditto	canary medium and yellow glass.	
12.—	Ditto	green tissue, yellow glass, and canary medium.	

The plate was afterwards developed, in a very weak developer; the illustration in Fig. 6 is a fair *fac-simile* of the resulting negative.

The reader will readily see that the squares most affected by light are Nos. 1, 3, 2, and 6, they being exposed respectively through daylight, green tissue, yellow tissue, and a combination of green and yellow tissues; whilst those affected the least, or, in fact, those not acted upon at all, are Nos. 11 and 12. It will be perceived that light filtered through a green tissue is almost as actinic as daylight, and, consequently, it is of no use as a light-transmitting medium; nor does it, when used in conjunction with other media, in my opinion, make the light so pleasant to the eyes as to outbalance the loss of light it undoubtedly retards.

The best light for ordinary work, then, is that transmitted through a combination of yellow or orange glass, yellow tissue and canary paper.

For the large window (that glazed with white glass) three frames should be made of laths or thick millboard to slide into the grooves. Two of these should be covered with one thickness of canary medium, and the other, one thickness of yellow tissue. The operator can then use one or all of the frames, according to his fancy, and the power of the light outside. The *canary medium* is a stout, greenish lemon-coloured paper, and is to be obtained from Messrs. Reynolds and Branson, *Commercial Street, Leeds*; the price is 3d. a sheet, 36 by 26 inches, postage, of course, extra. The *yellow tissue* is sold at all fancy stationers; the price is 1d. for two sheets. That of a pale yellow tint should be selected—the wrappers of this journal are a very good guide as to colour.

We must now return to the work in hand. The roof must be covered with some waterproof material; as a light, durable, and weatherproof water-repellent, I think I can safely recommend the "Willesden" paper, to be obtained from the Depôt, 34, *Cannon Street, E.C.* It is a very thick brown paper, coated with a solution which renders it perfectly rot and waterproof, and is sold in three thicknesses, which the makers term 1-ply, 2-ply, and 4-ply, the latter being as thick as medium millboard, and can be used *alone* for roofing, partitions, etc. The 2-ply should be used for *covering* the roof; it is fixed by simply nailing to the boards; it is sold in continuous rolls, 54 inches wide; the price is 1s. per yard per run. If the "amateur builder" prefer to use felt, he should endeavour to obtain it wide enough to cover the whole width of one side of the roof, so as to avoid lapping over, and must be fastened to the boards with zinc nails which are generally supplied with the felt. It must afterwards receive a couple of coats of tar, and should be re-tarred two or three times every year.

The dark room must be fitted internally with benches, shelves, sink, water and gas connections, etc.; the top of the benches stand 2 feet 8 inches from the floor; the one running along the side of the room is 22 inches wide, and is made of two 11 by 1 inch boards; that at the end is half that width, being made of one 11 inch board. A sink must stand in one corner; it is not necessary that it should be of large dimensions: one measuring, at the outside, about 24 by 18 inches, and should not be less than 6 inches deep at the inside, will be quite large enough, and for such a size the drawings have been made. One of the common enamelled brick type should be employed, as it is easier kept clean than if it were stone; it should have a flange about 2 inches wide running round the top, by which to support it on the timbers. The *modus operandi* of fixing timbers to carry the sink is shown in the accompanying cuts. I think little need be said on this subject, as the drawings in Fig. 7 are so explicit. In this A is the plan, B and C the side and end elevations. As to the benches, one end of each bench will rest on the timbers carrying the sink; the middle and far end of the bench must be supported by timbers similar to those carrying the sink. The narrow bench at the end of the building is supported by a piece of 5 by 1 inch board, nailed to the wall. A shelf the width of, and about a foot below, the wide bench should be fixed between the posts supporting the sink and that supporting the middle of the bench, for the reception of toning and developing dishes, and other large or heavy articles. The 6 feet by 9 feet board is securely fastened to the cross spar at the end of building, over little window, to form a handy shelf for bottles, etc. A ledge of wood, say 2 inches wide, is nailed to the edge of the shelf to prevent bottles, etc., falling off. As to the mode of making gas and water connections, I can say very little, not knowing under what circumstances they will be made. The water tap should stand fully a foot above the sink, and should also reach almost to the centre of it, so as to allow a pail or bottle being placed under it. Should the amateur be unable to get a supply of water from the mains, he would be enabled to collect a fair amount by placing spouting round the building, just under the roof, and running it into a cistern or tub. New wood spouting costs about 11d. yer yard. There should be two gas brackets placed at G in elevations in Figs. 10, 11, Sheet, and also a good gas stove for boiling water, etc., with several feet of rubber tubing, to allow for its being placed on any part of the bench. The best and cheapest stove I have ever seen for workshop use is Fletcher's No. 8 R; it can be obtained from Melhuish, *Fetter Lane*, for 2s., who also supplies white wired gas tubing at 2½d. per foot.

As I said before, white light is almost certain to enter between the door and door-posts. A movable

curtain should be put up over the door ; it should also be fixed in such a position that, if the operator wish to leave the room without admitting light, he may step between the curtain and the door, and, having drawn the curtain and made it secure, he can then open the door with perfect safety. To do this, 40 inches of $\frac{5}{16}$ inch rod iron is obtained, bent into a semi-circle, and the ends turned down 1 inch. Two staples are made and driven into the spars at end and sides near the door, into which the rod can then be put, as in Fig. 8. The curtain itself should be made of some dark material and should be fully 7 feet long—that is, it should be long enough to reach from the bar and trail several inches on the floor ; it is sewn to about a dozen brass rings and hung on the rod. One end of the curtain (preferably that nearest the end of the building, as it can be tacked to the door-post) must be secured, so that light can only gain entrance at one end when open. Above the rod another piece of cloth must be tacked to the roof, and should hang over the rod a few inches.

The walls and roof (at the inside, of course), should be papered. An excellent material for this is the "Willesden" 1-ply waterproof paper. My place I papered with a light green paper, costing 5d. per yard run, 59 inches wide. A small space was covered with ordinary wall paper, and, while the walls papered with "Willesden" paper are always dry, that papered with the latter always—especially in wet weather—feels damp. An old piece of linoleum should be laid on the floor, the outside of the building should be painted, and the amateur photographer's *sanctum* is complete.

My directions as to the construction of the dark room, have, of necessity, been very brief, but if the amateur should require further information on any point, I will endeavour to assist him in "Amateurs in Council."

[*Erratum in Folding Sheet.*—Readers are requested to note that the inscriptions to the Scale of Feet, appearing there, "Scale of Feet for Figs. 2, 3, 5, to 12," should read "Scale of Feet for Figs. 9, 10, 11, and 12." —ED.] (*To be continued.*)

PORTABLE GARDEN FRAMES.

By REV. A. THOROLD, M.A.

AMONG the many appliances for raising, preserving, and hardening off plants, both for the flower and kitchen garden, there are none more useful than the Portable Frames, which it is the design of this paper to describe.

There can be no question that a garden frame which possesses the recommendations of being strong, portable, easily made, easily taken to pieces, and at the same time is inexpensive, is a desideratum indeed for the amateur gardener and carpenter alike.

There are two sorts of garden frames which the amateur may construct with advantage to himself. Of these, one is after the usual type of the ordinary cucumber frame, and is made higher behind and lower in front, the sides sloping from front to back, and furnished with one, two, or more lights and divisions, as may be required—the lights sliding up and down at pleasure. This sort of frame is used for forcing, and lies on a hotbed. Its construction is simple, and clearly shown in Fig. 1, which, with the following description, is taken from Beeton's "Book of Garden Management":—

"The frame itself, be it of what size it may, is always made in the same stereotyped manner, so to speak—that is to say, the front is higher than the back, and the sides are cut so as to slope or slant from back to front in accordance with the relative height of these parts. A good proportion for the relative heights of back and front is 3 parts of the former to 2 parts for the latter—that is to say, if the front board be 12 inches high, the back should be 18 inches ; or if the front be 18 inches high, the back should be 27 inches. These are the heights at which the back and front parts of a garden frame are usually made, their lengths varying according to the number of lights with which the frame is covered ; and as garden lights, as a general rule, are 6 feet by 4 feet, so a frame will be 6 feet by 4 feet, 6 feet by 8 feet, or 6 feet by 12 feet, according as it is made to be covered by one, two, or three lights. The best way of making a frame is to construct the sides with tenons of some length, that pass through mortises cut for their reception in the ends of the front and back, as shown in Fig. 1, which affords a correct representation of a two-light garden frame, in accordance with the directions given above. In this, A and B represent respectively the front and back, and C the side nearest to the spectator. The mortises, tenons, and pegs by which these parts of the structure are connected and held together are shown at D, D, D, D. Ledges, lettered E E, are screwed on to the outside of the sides, and front and back are further connected by a slip of wood, F, which should be rebated on each side, or on which a slip should be nailed down its centre lengthways to form a rebate, in order to supply a bearing in which the inner edge of each light may slide up and down. In these bearings and in the top of each side a semicircular groove should be cut from top to bottom to catch and carry off any rain that may find its way in at the edges of the sides of the lights. The lights are made of stuff from $1\frac{1}{4}$ inch to $1\frac{1}{2}$ inch thick, and are furnished with three or more grooved sash bars, as shown, and strengthened by a flat iron bar about

$\frac{3}{16}$ inch thick and 1 inch wide, let into the under side of the framework of the light, and passing through slots cut for it in the sash bars. This bar is shown at H in each light, and at G an iron handle, which is screwed to the edge of the top of the frame to afford means by which it may be more easily pushed down or drawn up into its place

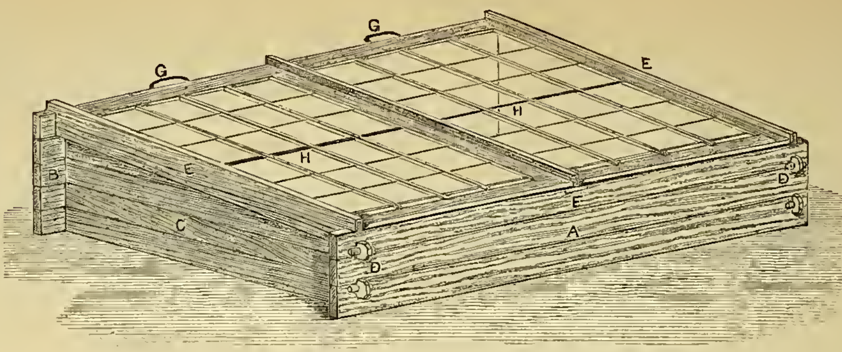


FIG. 1.—A TWO-LIGHT GARDEN FRAME OF ORDINARY FORM.

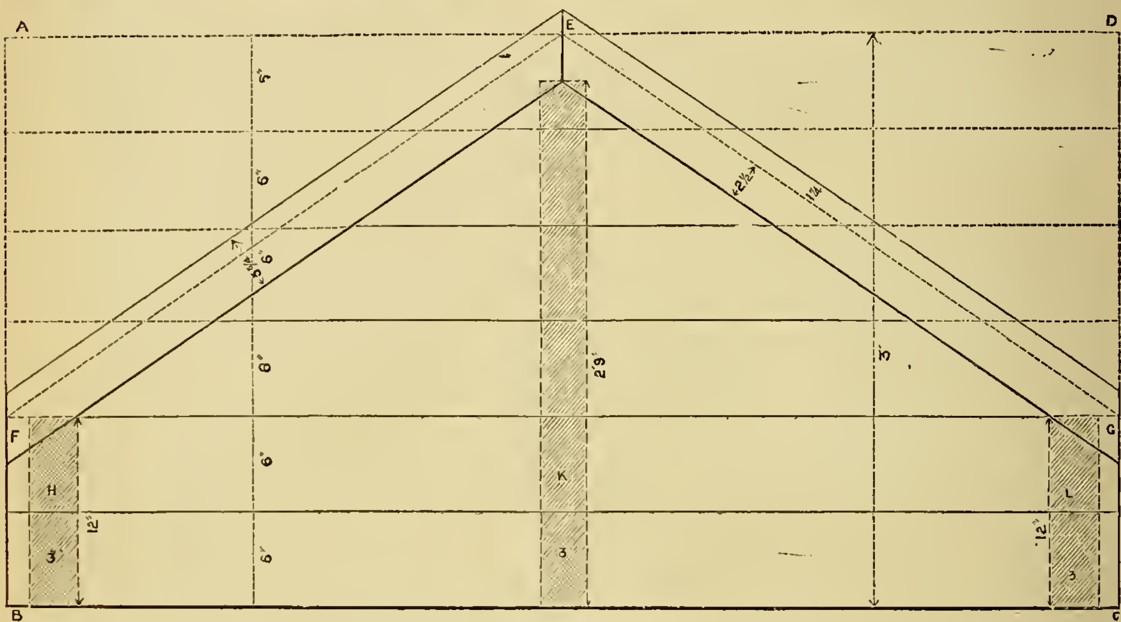


FIG. 3.—END OF SPAN ROOF GARDEN FRAME, SHOWING ITS CONSTRUCTION EXTERNALLY AND INTERNALLY. Scale, one inch to one foot.

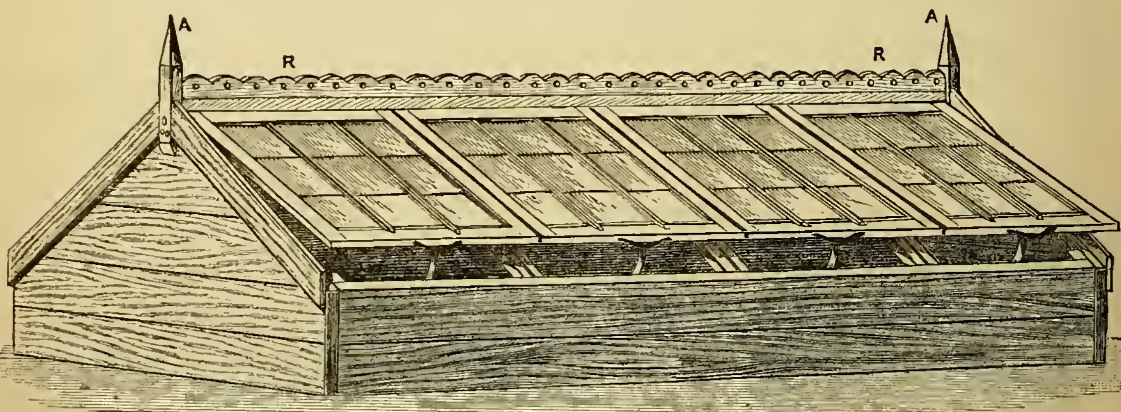


FIG. 2.—PORTABLE GARDEN FRAME WITH SPAN ROOF.

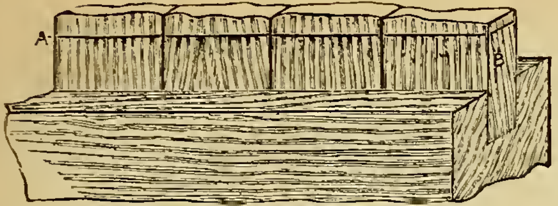


FIG. 4.—MODE OF JOINTING WITH LATHS.

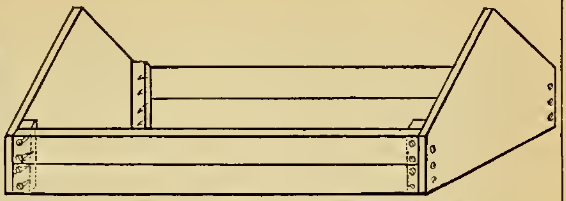
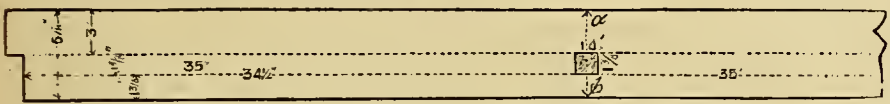


FIG. 5.—MODE OF JOINING SIDES AND ENDS.



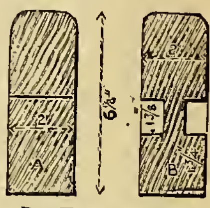


FIG. 6.—TOP RAIL, FRONT ELEVATION. Scale, 1 inch to 1 foot. A, END ELEVATION OF RAIL. B, TRANSVERSE SECTION OF RAIL along *a b*. A and B on Scale of 2 inches to 1 foot.

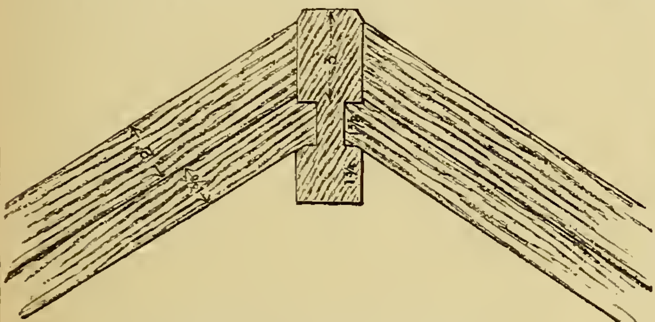


FIG. 8.—BATTENS ON RESTS FOR LIGHTS. Scale, 2 inches to 1 foot.

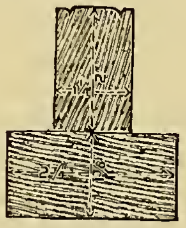


FIG. 9.—SECTION OF BATTEN FOR LIGHTS. Scale, 4 inches to 1 foot.

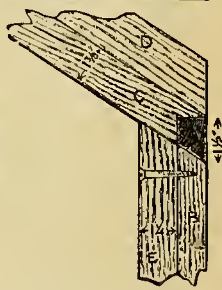


FIG. 7.—MODE OF NOTCHING SIDE TO RECEIVE BATTEN.

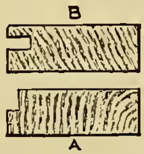


FIG. 12.—SECTION OF TOP RAIL OF FRAME along line *c d*. Scale, 3 in. to 1 ft.

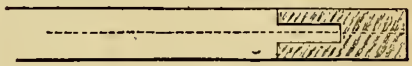


FIG. 13.—ATTACHMENT OF BAR TO TOP RAIL. Scale, 3 inches to 1 foot.

FIG. 14.—ATTACHMENT OF BAR TO LOWER RAIL. Scale, 3 inches to 1 foot.

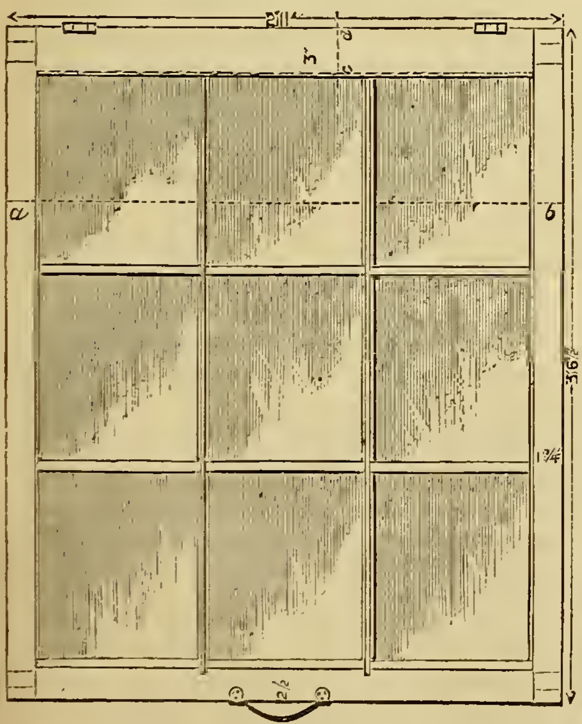


FIG. 10.—PLAN OF GLAZED FRAME, SHOWING CONSTRUCTION, ETC. Scale, 1 inch to 1 foot.

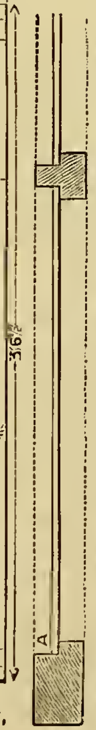


FIG. 11.—PART OF SECTION OF FRAME across line *a b*. Scale, 3 inches to 1 foot.

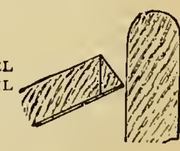


FIG. 15.—BEVEL OF TOP RAIL OF FRAME.

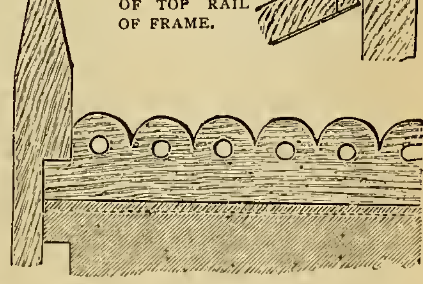


FIG. 16.—CRESTING, ETC., FOR FRAME, IN SECTION.

when down. Frames should be glazed with 21-oz. glass." Another sort of frame is made on the principle of the greenhouse, and is in reality one in miniature. It has a span roof, and the lights, instead of sliding, as in a cucumber frame, are hung with hinges to a top rail, nd open upwards. A general view is given in Fig. 2. Such a frame is intended to stand on the ground wherever most convenient; but the more open the spot the better, for the sake of the light.

The span roof garden frame possesses the two great qualifications which most people aim at, though often fruitlessly—efficiency and appearance. It is certainly efficient, since it allows a far greater width across than can be obtained in a cucumber frame, and if used for plants, will not be found to draw them so as to cause spindly growth, which is often the case when the light is only admitted from one side; while as to appearance, it can be made really ornamental, which can never be said of a cucumber frame.

The builder of the frame, as shown in Fig. 2, must, of course, please himself in the exact measurements he may think best for his requirements, but for general purposes the following table, stated in round numbers, will be found useful :—

Length.	Breadth.	Height of Front.	Height of Ridge.
6 ft. ...	4 ft. ...	12 in. ..	2 ft. 3 in.
8 ft. ...	4 ft. 6 in. ...	12 in. ...	2 ft. 6 in.
12 ft. ...	6 ft. ...	13 in. ...	3 ft.

We will suppose that our intention is to erect a frame 12 feet by 6 feet. In making it, however, we will not include the thickness of the ends in the 12 feet, so that actually it will be 12 feet 2 inches long and 6 feet wide, *external measurement*.

We begin with the ends, one of which is shown in Fig. 3 by that part of the figure which is drawn in solid lines. The best material for our purpose is red deal planking, 6 inches wide by 1 inch thick. The full height of each end being 3 feet, we shall require six lengths, each measuring 6 feet long. Plane these up, shoot the side edges, and run two return beads along both sides of each length. These planks are now to be tongued together; we therefore proceed to plough grooves along both the edges of four out of six of them: the other two need only be grooved on one side. A great deal depends upon the stability of these two ends; it will therefore be found best to tongue them by a method a little out of the ordinary way. When grooves are cut in both edges of the surface to be tongued, the general plan is to tongue them with a thin lath cut to the size of the grooves; but as the grain of the lath runs the same way as the grain of the pieces to be tongued, a very slight blow or strain will fracture it along its entire length, there is clearly very little strength in such a joint. The same fault is to be found in the tongues cut out of the solid edge by match planes; for by this method also the grain of the tongue lies parallel with the grain of the solid.

A far more satisfactory joint, however, can be made by grooving both edges, as for an ordinary lath tongue, and inserting and gluing side by side a series of short lengths cut from a prepared lath, so that the grain of the tongue is at right angles to the grain of the board (see Fig. 4). When dry and hard, a line, A B, can be run along, and the pieces inserted cut off with a tenon saw to the required length. All the grooves and tongues being prepared, we may proceed to put the ends together; but only two planks should be glued up at a time, and these must be rubbed together in the usual way. When all the six planks have been thus dealt with, we shall have before us a slab like A B C D, in Fig. 3. This must now be cut to the necessary shape. Take a chalk line and mark the slab as shown in the lines E F, E G, in Fig 3, then with a fine handsaw remove the corners D E F, D E G, and run a plane down after the saw for a clean edge. Next plane up some scantling, 3 inches by $1\frac{1}{2}$ inch, or even 2 inches, cutting one length of 2 feet 9 inches and two lengths of 1 foot, and screw these down on the *inside* of the side just finished, as shown in the shaded pieces, H K L, in Fig. 2. The longer length, it will be seen, runs down the centre, and the two shorter pieces 1 inch in from the side edges. Now cut four strips of half-inch deal $3\frac{1}{4}$ inches wide and 4 feet long; mitre them at one end to the angle at E, Fig. 3, and fasten them, two on each end, as in the solid lines in the figure, so that they shall project upwards $1\frac{1}{4}$ inch beyond the edges of the sides, shown by the dotted lines E F, E G. When in place, any superfluous length can be removed from the corners at their lower extremities. Both ends are alike in every way, it will not be necessary, therefore, to describe the second; both, however, should be prepared before the remaining parts are thought of.

Both ends being out of hand, we may proceed to the sides. These must correspond in height with the height B F, C G, of the ends which, as it has been already said, measures 12 inches.

To make the sides take two boards a little over 12 feet long and 6 inches wide, 1 inch thick; plane up on both sides, shoot the edges, and groove and tongue them together as before described, glue up and rub together, and when dry and cleaned off, and the ends trimmed to bring them exactly to the length of 12 feet, one side will be finished. Two of these are required.

The sides and ends may now be fastened temporarily together by means of 4 inch screws, as shown in Fig. 5. And this, by the way, will be the mode of fastening together finally a screw of a size longer being used in the final operation of screwing together.

It will be seen that the sides of one frame fit up against the ends, as in Fig. 5, and are kept in place by screws passed through the ends, and by the short lengths of scantling on the inner face of the two ends. This method of fastening the sides and ends together is fairly strong, but of course it cannot be compared to the plan of carrying long tenons through mortises in the ends, and then dropping an iron key close against the outer face of the end and perpendicularly through the projecting tenons as in Fig. 1.

The first plan is easy, but it will well repay the builder of this frame to put more time and work into it, and cut three good tenons and mortises instead.

If this plan should be decided upon, it will be necessary to cut the sides 6 inches longer than already given, to allow for cutting the 3-inch tenons at each end, and the sides must correspondingly also be 6 in. wider to permit the requisite mortises to be made.

We must now think about the top rail. The top rail R, in Fig. 10, and upon which the lights are hung, is a sound piece of scantling 12 feet 2 inches long, $6\frac{1}{2}$ inches deep, and 2 inches thick, and when in place must rest on the top of such of the two ends, namely, E in Fig. 2, fitting down also on the heads of the uprights, on the inside of the ends shown at K, Fig. 2.

When we have chosen a suitable length, we may proceed to plane it up. The edges on one side should be left square, but on the upper side they should be rounded, as shown at A, B, Fig. 6. We then mark out and cut each end, as shown in Fig. 6, which represents the left hand end of the top rail, and which is drawn on a scale of 1 inch to a foot. The amateur can easily see from this the mode of dealing with the entire length of the top rail. The end elevation of the rail is shown in Fig. 6, on a scale of 2 in. to 1 foot.

Having marked out and cut the notch at each end, place the rail on its side, and mark the position of the slips or battens upon which the lights are to rest when closed. Then mark and cut out mortises, as shown in Fig. 6, $1\frac{1}{4}$ inches wide, $1\frac{3}{8}$ inch long, $\frac{3}{4}$ inch deep; now turn the rail over, and again mark out the position of the mortises on the other side, cutting them out of the same dimensions as those just described. Fig. 6, B, shows section of top rail through A B, drawn like A, on a scale of 2 inches to 1 foot.

The sides, ends, and top rail being in place, cut notches in the sides to carry the lower end of the battens upon which the lights are to lie. These notches are not square at the base, but are bevelled away in front to allow the battens to rest in them at the right angle. To cut these notches accurately, we must take account of the thickness of the battens that are to fall into them, and the angle which they make with the side, which, of course, is perpendicular. As the batten is $1\frac{3}{8}$ inch in thickness the notches will assume the form shown in section at A, in Fig. 7, B representing the side in section, and C the batten. Fig. 7 being on a scale of 2 in. to a foot, the back of the notch is about $\frac{3}{4}$ in. deep, and the front $1\frac{1}{2}$ in. deep; therefore mark a line inside, $\frac{3}{4}$ in. below top edge, and another outside, $1\frac{1}{2}$ in. below top edge; saw down to the lines, on either side, and remove the wood between the saw kerfs with a chisel. The edges of the sides must be set out to correspond with the mortises in the top rail.

Now cut six short lengths of scantling 12 inches long and $2\frac{1}{2}$ inches wide, by $1\frac{1}{4}$ inch deep; plane them up, and screw one under each of the apertures on the inside, as shown at D, in Fig. 7.

We may now think about the battens to sustain the lights, shown in side elevation in Fig. 8 and in section in Fig. 9. Six will be required. Rip out and plane up a strip of deal 3 feet 8 inches long, $1\frac{1}{4}$ inches wide, and 2 inches thick; work a return bead along the two edges of one of the narrow sides. Cut one end as shown in Fig. 8. Then take another strip 3 feet 10 inches long, $2\frac{3}{4}$ inches wide, and $1\frac{3}{8}$ inch deep, and on one side $\frac{1}{2}$ an inch from each edge run a hollow from end to end. Now screw the strip just described upon the latter one, so that the narrow edge of the stouter piece shall lie on the wide side of the thinner strip, with an equal amount to spare on each side. These pieces should be flush with each other at one end, while at the other (top end) the lower strip should project two inches beyond the upper. Fig. 8 shows a section of these strips, as well as the side elevation, with the lower one tenoned at the upper end to fit the mortises in the top rail in Fig. 6, as before described. Fig. 8 also shows a section of their relative positions when in place. With Figs. 7, 8, and 9, a plan of the batten or compound rest for light is unnecessary. When these battens are secured in place, the frame itself is complete.

Eight lights are now required. One of these is shown in Fig. 10; and, for the better explanation of the *modus operandi*, we will make one together.

It not unfrequently happens that even carpenters by trade are a little out in their measurements in such a frame as is now under our consideration, and, in consequence, the lights are not of one size all round—hence it is found needful to put marks to correspond on the rests and lights which have been fitted to each other. Of the amateur we must confess that he is not sometimes out in his measurements, but nearly always; so if he wishes his lights to be at all ship-shape, each light must be carefully made to fit a corresponding set of rests. This will be best done by starting at one end and working steadily round, marking them as he goes. We begin then at one end of the frame by taking the measurements top and bottom between two rests, thus :—

1″	2′ 11″	$1\frac{1}{4}$″	2′ 11″	$1\frac{1}{4}$″	2′ 11″	$1\frac{1}{4}$″	2′ 11″	1″
A	C	B	C	B	C	B	C	A

In the above setting out of the length of the frame it may be as well to show that :—

A, A (thickness of ends)	=	1 in. by 2 =	0 ft. 2 in.
B, B, B (width of bars between frames	=	$1\frac{1}{4}$ in. by 3 =	0 ft. $3\frac{3}{4}$ in.
C, C, C, C (width of frames)... ...	=	2 ft. 11 in. by 4 =	11 ft. 8 in.
			12 ft. $1\frac{3}{4}$ in.

Absolute exactness might have been obtained by making the width of the division bars between the frames $1\frac{1}{3}$ in. instead of $1\frac{1}{4}$ in., but the above, which is only $\frac{1}{4}$ in. out, is near enough for all practical purposes. The length of the frame was stated in round numbers to be 12 ft., but actually it is 12 ft. 2 in., the boards of the sides being 12 feet long, and the thickness of the ends taken together being 2 inches.

To make the frames, rip out two strips—one out of 1-inch stuff for the top, and another out of $\frac{1}{2}$-inch stuff for the bottom—and plane up. The length of the strips must be according to the measurements taken, and the width of the top rail should be 3 inches, and that of the bottom $2\frac{1}{2}$ inches.

Then rip out and plane up two more strips out of 1-inch stuff, and $1\frac{3}{4}$ in. wide, for the sides, and run a rebate $\frac{1}{4}$ inch deep and $\frac{1}{2}$ inch wide on each inner edge for the glass, as shown at A in section of frame in Fig. 11, and rebate the inner side of the top rail, as shown at A, Fig. 12. This had better be taken out with a chisel, after the whole frame is put together. The usual way is to groove the top rail for the reception of the glass, as at B, but the amateur might find this difficult, as he may not have a grooving plane. If you are a neat hand with your tools, these may be tenoned and mortised together in the usual way; but if you are nearly sure to make ill-fitting joints, do not risk an unsatisfactory piece of work, but simply halve them together, using short thick (well greased) iron screws to secure them. Indeed, as the lower rail is only half the thickness of the upper rail, it is certainly as well to cut notches in the under side of the side-pieces to receive the ends, and not to attempt to connect the parts by mortise and tenon. The halved joint is always a strong joint, and is easy to make. Before, however, these side and top rails are fastened up for good, the two narrow bars to carry the glass must be prepared and tenoned into the top rail, and notched into the bottom rail.

These rails are shown in section lengthways in Figs. 13 and 14. They are 3 ft. $4\frac{1}{2}$ in. long, 1 inch wide, and 1 inch deep, the upper edge is rebated $\frac{1}{4}$ inch in on each side, and $\frac{1}{2}$ inch deep, to afford ledges for the glass. The rebates should be made before the bars are tenoned into the rails.

The upper end must be cut for a tenon, and fitted into a mortise to correspond in the upper rail, as shown in Fig. 13. The lower end is cut somewhat differently to the upper, as it is usual to splay it over the lower rail, as in Fig. 14. This figure shows the method of cutting this lower end ; it looks a little complicated, but there is no practical difficulty if a little care is taken. The thin part of the bar is carried out over the bottom rail, the thicker part below it being cut away, as at A, and beyond this a portion, say half of the thick part, is again cut away for the necessary length, and the part that remains is dropped into a notch, as at B. The bar and rail are then screwed together as shown.

When the inner bars are cut and let into the top and bottom rails, so that the upper surface of all the parts, except the bottom rail, are flush with each other, the entire frame may be finally put together.

When the completed light is slipped into its place, it will be found that the top end being square, the frame will not fit up home against the top rail, but will present an appearance like Fig. 15. It must therefore be once more taken out, and the under edge of the upper rail of the light be bevelled till a proper angle is obtained (see lines in part to left, Fig. 15), and the light fits up tight to the rail. If it is thought desirable, for appearance' sake, two points, or pinnacles, A, A, Fig. 2, and the ornamental cresting, R, R, can be added to the top of the frame. The pinnacles should be halved in the lower part and screwed to the sides, the upper parts of the strips screwed to the exterior of the ends being cut away, to allow the pinnacle to drop into its place and sit against the surface of the side. A groove should be run along the centre of the top-rail to receive the cresting, Fig. 16, which may be ornamented according to taste.

Now let two iron butts into the lights, preparing similar beds for them in the upper rail, affix handles, also arms and catches to hold the light open as required, and nothing will remain but to add the two coats of paint, which are requisite before glazing. If you attempt to glaze before painting, the bedding of putty is certain to crack away from the wood.

The glass should be obtained ready cut (21 oz.) at a wholesale glass cutter, with sufficient putty.

Do not forget before bedding in the glass to drive in a small brad below each corner of the bottom panes. This support is absolutely necessary, and, if omitted, the glass is apt to drop from its place through its own weight, the putty not having sufficient cohesive power to support the weight put upon it. Eventually a further coat of white paint may be given to complete the work.

HOW TO MAKE A SHOCKING COIL.

By THOMAS FAWCUS.

THE coil I am about to describe is one I made a short time ago, and which works extremely well, giving an exceedingly strong shock when connected with a half-pint bichromate battery. It is a very convenient size, being easily carried about, costing little for materials, and being much more "shocking" when at full power with above cell than is pleasant. If any reader will follow my instructions he cannot fail to make one for himself.

First turn two pieces of any hard wood or ebonite, or ivory, 1½ inch diameter, ¼ inch thick, with a hole 5/16 inch diameter through the centre. These pieces must be filed flat at one part of the rim so that they will rest level on the base-board (see Fig. 1). The raised part of the rim is simply for the sake of appearance. Next get a piece of brass tubing, such as is sold at fishing-tackle shops, about ¼ inch diameter by 3 inches long, and round it wrap several folds of glued note paper 2¾ inches wide, so as to make a paper tube 2¾ inches long, and just of sufficient diameter to fit tightly into the holes in end pieces. This done, withdraw the brass tube and allow the paper one to dry thoroughly. When quite dry, glue on the wooden end pieces, taking care to get them at right angles to tube, and also to get the flat part of rims exactly opposite each other. After the glue has become quite hard and dry, plug up the ends and soak in melted paraffin wax. The reel is now finished ready for the wire, which consists of two layers of No. 18 W.G. cotton-covered copper wire (about one ounce) for the primary, and two ounces of No. 36 W.G. silk-covered copper wire for the secondary. First drill a hole through the wooden end close to the paper tube, put a few inches of the primary wire through this hole, and wind on the remainder as closely together as possible. As soon as the first coil of the primary is wound on, take a piece of tissue paper (soaked in melted paraffin wax) the exact width of reel between the ends, and wrap it once round; securing it there with a piece of thread until you wind on the second coil. A hole must be drilled through the wooden end at which the primary wire finishes, through which the end of wire must be put. This done, wrap several thicknesses of waxed paper round it, so as to leave a smooth surface for the secondary wire.

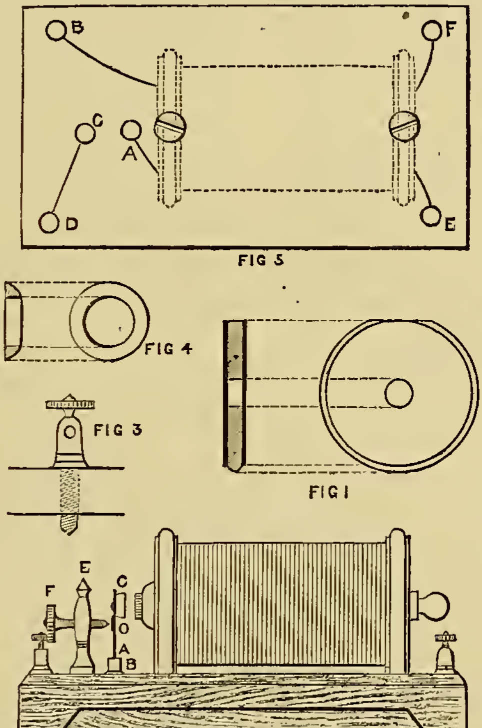


FIG. 1.—WOODEN ENDS (half size). FIG. 2.—COMPLETE COIL, SHOWING CONTACT BREAK (half size). FIG. 3.—TERMINAL (enlarged). FIG. 4.—SMALL BRASS RING FOR CONCEALING JOINT OF CORE AND END PIECE (full size). FIG. 5.—DIAGRAM OF UNDERSIDE OF BASE BOARD, SHOWING CONNECTIONS (half size).

The winding of the Secondary is a much more delicate operation than that of the primary; every care must be exercised to see that no breaks occur, and also that the wire is not stripped of its silk covering in any place, in which case it must be re-covered with a piece of silk thread. It must be wound on quite regularly, similar to cotton or silk upon ordinary sewing thread reels. If there should be a break at any part, it must be soldered and covered with silk.

A lathe with a very slow speed is a great help in winding this wire. Commence at the opposite end to which the primary wire commences and finishes; drill a hole as before, and wind on slowly and evenly, covering each coil with a piece of waxed paper, and taking care that no part of one coil descends to the level of the previous one. There will be about fourteen coils, and they must finish at the same end as they began.

Having got on the wire, while still in the lathe, get some ordinary sewing cotton and wind a coil or two over the wire, then take it out of the lathe, plug up the ends and soak in melted paraffin for an hour or two.

The core is the next thing for consideration; this is made of iron wire, No. 24, B. W. G. The brass tube before mentioned must be cut down to 2⅜ inches, and filled with pieces of wire the same length. Slide the wires thus collected out of the tube at one end, and bind into a bundle with thin wire; make this red hot in the fire, and bury amongst the cinders to cool gradually. As soon as cold, place it in melted paraffin for a few minutes, then take off the binding wire, and

the remaining wires will be stuck together by the wax, thus forming the core.

This must be fixed in tube in centre of coil. Let it project ¼ inch out at one end, and fix it there with small wooden wedges and a little paraffin run in to make all tight. Now fix a small wooden, brass, or ivory knob into one end of the brass tube, and slide it over the core. This forms the regulator. When it is entirely out the shock is strongest. With it the force of shock can be regulated to a nicety.

The next thing is the contact break. Fig. 2 will give you a good idea of its construction. First get a piece of sheet brass and hammer it out as thin as possible, and cut it down to length of spring A in sketch, and about three-sixteenths of an inch wide. One end of this spring must be soldered into a small brass foot B, and to the other a soft iron clapper C, must be attached; at D a small piece of platinum must be soldered on to the spring. This must be carefully done so as not to overheat the spring. The best way to do it is this: Get a piece of thin solder about the size of your platinum; lay the solder on the spring, and the platinum on top of the solder, using spirits of salt as a flux, then apply a match. Now turn the pillar E; on a level with the platinum or spring drill a hole and tap it with about one-sixteenth inch thread; then make the set screw F, which must also have a small piece of platinum on the end of it. Solder this similarly to that on spring; drill a small hole a short distance into the end of screw, and into this put a small piece of solder with spirits of salt. Then take the platinum with a pair of pliers in one hand, and the set screw in the other, and pressing the platinum into end of screw, hold it to the gas to melt the solder. After it is quite cold file to a nice point.

There are four terminals wanted like Fig. 3; these you can buy ready made, or you can turn them yourself, just as you like. The sketch explains itself, I think. The screw on top is to firmly fix the wire (connecting, say, the battery to the coil), which passes through the small hole.

You can also turn a small brass ring (see Fig. 4); this is to hide the joint between core and wooden end piece, and adds greatly to the appearance of the coil.

Now proceed to fix all upon the stand or base-board, which is simply a piece of mahogany 4¾ inches long by 2½ inches wide by ¼ inch thick. First secure the reel itself by means of a screw passing through base-board into each of the ends; then drill two holes at each end of reel through base-board, through which pass the wires to form the connections. Now fix contact break, as shown in Fig. 2.

Note.—The clapper must be quite close to the end of the core, but must not touch it, and the platinised screw must touch the platinum on spring; in fact, it is to press clapper towards core when desired. A terminal must be screwed into base-board at each corner. The ends of all terminals, foot of screw, and pillar must project a little through base-board.

Before securing reel to base-board, a piece of silk may be put round it, or thick green cord wound evenly on looks very well.

The connections must now be made; the primary wire must be arranged to pass the electric current through the contact break; therefore one end must be soldered to the foot carrying spring (see A, Fig. 5), and the other end to terminal B; then connect adjusting screw pillar C and terminal D by means of a piece of copper wire. The secondary wires are each to be soldered to one of the unused terminals E and F. The coil is now complete, but it is best to cover up the under part where the connections are. This is effected by means of a thin piece of wood gouged out at certain parts to take the ends of terminals, etc., so as to be flush at the edges. Of course, this stand may have a moulding cut on it, or may be otherwise ornamented; mine is cut away to form feet as in sketch.

The best battery for this coil is a half pint bichromate of the bottle form, which has a sliding brass rod attached to zinc so that it may be raised or lowered as desired. When in use the zinc is lowered into the exciting fluid, and when not in use it is raised out of it, and may be left so for any length of time without losing its strength. The exciting fluid is made by dissolving 2 ounces of bichromate of potash in 1 pint of hot water, and when cold adding sulphuric acid in the proportion of 1 part of acid to 12 parts of bichromate solution.

When in use the battery is connected to the terminals of the primary wire by means of two pieces of copper wire. The handles or directors (which are pieces of brass tube 3 inches long by about ¾ inch diameter) are attached to the secondary terminals. The current of electricity passes from one terminal through the primary wire to the clapper spring, up the spring to the platinum pointed screw, and down that to the other terminal. As soon as the current passes, the wire core in centre of coil becomes a magnet and attracts the clapper; as soon as this leaves the platinum screw the current is broken, and the core loses its magnetism, when the spring carries the clapper back again to its original position, and completes the circuit. The operation is then repeated at a very quick rate. This is the cause of the continuous buzzing. This rapid rupture of circuit excites momentary currents (called induced currents) in the secondary wire, and it is from these secondary currents that the shock is obtained.

GLASS PAINTING AND DECORATIVE GLAZING.

By L. L. STOKES.

IV.—INITIATORY WORK—MEDALLIONS, BORDERS, DIAPERS, ETC., IN STAINED GLASS.

INITIATORY WORK.—Having thus gone through the various processes, and it is trusted in so full and explicit a manner as may enable the would-be glass painter to understand and follow them without being obstructed by any serious difficulties, it will be well to give some advice to the tyro as to the best way of beginning his labours. It is to be taken for granted that the pupil knows something of drawing, and so much of water-colour painting as to be able to use a brush with facility, for without such knowledge he cannot hope for success in the artistic part of the work; and he will do well either to acquire this knowledge in the ordinary way, before he meddles with glass, or else to confine his efforts to plain pattern glazing—which will be treated of in its proper place—and by which good decorative effects are to be produced by means which demand little or no artistic skill.

And here it may be mentioned for the convenience of those who may wish to work on glass without the preliminary labour of preparing the design and cartoon, that artistic cartoons are to be borrowed on hire, ready drawn. Such may be had from Miss Collingridge, 22, *Beaumont Street, Portland Place, W.* Intending amateurs, who fear to enter on the art by the aid of printed directions alone, may also have lessons in glass painting from the same lady.

As a preparatory step to his work on the coloured material, the beginner is advised first to take a piece of plain window glass, and placing it on his transparent easel, to try how far he can succeed in drawing firm and equal lines upon it with his lining-brush and gum tracing-colour. He will do well to try this with nothing of the nature of a cartoon, and only a piece of plain paper behind his glass; for he will then see his strokes plainly, and be able to judge how far they are satisfactory.

When he finds that he can line with steadiness, let him try some design, but still on a piece of ordinary glass. The half-length figure of the Page (Fig. 3) will not be a bad subject for the purpose, as it is well made out and boldly lined. Besides, if the operator should be pleased, as it is hoped he may be, with the result of his first attempt, this design will be sufficiently attractive to be worth firing and preserving. If preferred, it may be treated as a medallion, and painted on a circular piece of glass, as shown by the dotted line in Fig. 4. This is mentioned since medallions are always in request for working up in modern window and screen decorations.

The design is to be enlarged to any size desired, and a cartoon drawn, in which the lead lines must for our present purpose be considered as bold outlines merely, and with the aid of this cartoon the operator should proceed to work out the figure in lines only. In this first lesson no mat is to be used. A mat has, as we have seen, and shall presently more fully see, important uses; but it would offer serious difficulties to a beginner. It is not to be supposed that a beginner will make his lines with absolute certainty, and the mat would be spoiled by wiping out a false line. There are, moreover, many little accidents to which beginners are liable, which would be likely to injure the mat. It is, therefore, better to leave matting alone for the present, and to work out the effect in bold and fine lines, something in the same manner as in old wood engravings. From this work a false or imperfect line, can be wiped away when necessary. Shadow is to be given by hatching, and, where required, by cross-hatching. Hatching, it will be remembered, consists in laying light lines at regular intervals, as at Fig. 14. This deepens tone without destroying transparency, and is suggestive of modelling. Cross-hatching, as at Fig. 15, gives greater depth of shadow. Crossing the lines at an acute angle, as shown, results in delicacy of effect; but crossing them at an obtuse angle produces a rugged appearance. Satisfactory effects of light and shadow are to be obtained by lining merely; or if more shadow should be desired in touching-up, it is possible afterwards to shade over it with tar-spirit tracing-colour.

The lining finished, the flesh tint (China pink or flesh red) can be brushed over the face and hands, and the work might be enlivened by gold-stain—say on the belt and collar, the brooch upon the cap, and the hilt of the sword; or, instead, if the design is treated as a medallion, the whole background might be stained yellow, in place of the square quarries.

Fig. 3 was, however, more especially designed as a subject for the line work only on coloured glass, and when the above preliminary exercise has been gone through, it may be cut out in that material. The colours of the stained glass to be chosen may be left much to the individual taste of the worker, but it may be said broadly that the dress should have strong colours; that the background should be in low tints; and that the border again should be in strong colours, whilst the hands, face, and hair must be in white glass. There is, moreover, a tradition among glass painters that a line of white glass ought to run round the edge of the whole work, and such a line is shown

as inserted in this design. In the opinion of the writer, however, the use or neglect of this rule is a matter in which the worker has a right to please himself.

These pieces of stained glass are not to be matted, but when they have been fixed on the easel, whatever shadow is required is to be obtained, as in the study on plain glass, by lining; and by a little subsequent shading with the tar-spirit tracing-colour. The ornamental work in dark and light which runs round the border, and of which a variety of patterns are given, is produced in a very simple manner; namely, by laying on a solid coat of tracing-colour, as shown in the central compartment at bottom, and then removing so much of it as is required to form the pattern, by scraping with a box point.

As by this time the worker will have grown tolerably familiar with using the brush on glass, he will do well to try his hand at laying a mat. A piece of plain glass will be best for this purpose. As a small and simple subject for a first attempt, he may take the diaper, Fig. 16. In this there are a few bold lines in gum tracing-colour, but otherwise the effect is chiefly obtained by scrubbing and scraping away the mat. The central boss and veins in this diaper may afterwards be enlivened by staining yellow. Such simple diapers when repeated as quarries, or in borders, often have a very good effect.

FIG. 17.—MEDALLION—MAN IN THE MOON—SUBJECT FOR BITING IN ANO GOLD STAIN ON BLUE GLASS.

A more important subject for matting and working out on white glass in grisaille is the medallion, Fig. 10. Removing portions of the mat with the hog-hair scrub will in this also give great part of the modelling of the figure, which will be completed by a very little hatching, and different depths of shading in the tar-spirit colour. In this, when completed, the table in front of the figure is to be white; the vase, crown, petals of sunflower, and all orfray-work about the dress, gold-stain; the remainder of the work, matting colour. Such a medallion, enlarged to twice or three times its present size, would look well as the centre of a

window-light; the remaining space being filled either with quarries worked with a diaper in light grisaille, or with geometrical plain-pattern glazing in one or two low tints.

FIG. 18.—EXAMPLE OF BORDER IN THREE COLOURS.

Medallions, Borders, Diapers, etc., in Stained Glass.—Whilst we are upon the subject of medallions, it may be remarked that just a head, merely lined and shaded in tracing-colour on cathedral glass, generally looks well in connection with "Queen Anne" glazing; and that for work of an "Elizabethan" character, we may more appropriately use heraldic designs, brought to a medallion shape. The general features of Fig. 11 may be retained, and the arms varied with those of many different families. In no other material do the brilliant tinctures in which heralds delight tell with so much effect as in stained glass. In Fig. 17 we have a medallion of a very different type, yet one which is to be carried out in somewhat the same manner as Fig. 11. This design (a fanciful representation of the moon) is to be worked on a disc of blue flash-glass. For the sky background the blue is to remain untouched; the remainder of the surface is to be bitten-in. The "Man in the Moon," with his dog and faggot, are to be in tracing-colour, with China pink or flesh red for the flesh; the bill-hook may be left white. The crescent moon is to be made yellow with gold-stain.

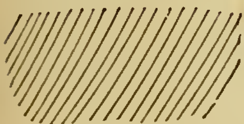


FIG. 14.—HATCHING.

FIG. 19.—CONSTRUCTION OF DIAPERS, AND THE REPETITION AND COMBINATION OF PATTERNS.

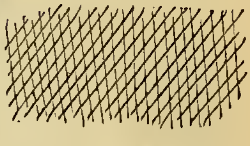


FIG. 15.—CROSS HATCHING.

Fig. 18 shows a repeating border for use in Gothic work. It is intended to be worked in three colours; pieces *a* and *c* are green, *b* is purple, and *d* is red. They have to be shaded with deep tracing-colour. In Gothic windows much richness of effect is to be produced by the judicious introduction of such borders.

When backgrounds in the same style have to be filled in, diapers in grisaille, enlivened with a little gold-stain, are a frequent resource. Treated in this manner, mere white glass may with comparatively little labour be rendered highly decorative. Fig. 19 illustrates the principles on which to construct diapers and repeating patterns. Nearly all of them are based upon lines dividing the space regularly

FIG. 21.—EXAMPLE OF BOX-POINT WORK.

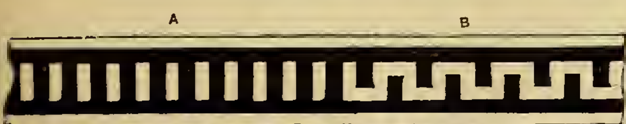


FIG. 20.—EXAMPLE OF BOX-POINT WORK.

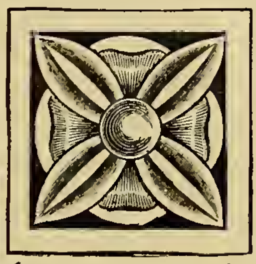


FIG. 16.—DIAPER FOR GRISAILLE.

and into aliquot parts. During the Gothic period, much ingenuity was shown in the adaptation of these principles, not only to diapers, etc., in stained glass, but also to encaustic tiles, and to other purposes; but perhaps of all designers the Spanish Moors were most successful in producing ornament by the use of arithmetic, the rule, and the compasses.

Figs. 20 and 21 show the construction of borders for garments, etc., and the manner in which they are most easily and quickly worked out by the help of the boxwood point. In Fig. 20 it will be seen that bold lines are drawn in along the top and bottom of the border, and connected at right angles, as at A, by lines whose thickness and the spaces between which are the same. By scraping off alternately the tops and bottoms of the connecting lines, the fret-pattern, as at B, is quickly produced. The key and various other patterns, including that given in Fig. 21, are not less easy of production.

(To be continued.)

SMITHING AND FORGING.

By GEORGE EDWINSON.

III.—MAKING TONGS, STAPLES, HASPS, HOLDFASTS, AND BRACKETS.

IN looking over a list of tools used in any smithy, however small and badly furnished it may be, we find it difficult to determine the line which separates the really necessary tools from those which may be named mere accessories, for, as the skill of the smith grows with practice, his wants will keep pace with his skill, and he will feel the need of tools as means wherewith to work out the new ideas which present themselves to his mind. At the first outset, however, the tools of the amateur or novicial smith may be few and simple, and these may now be purchased ready to hand in almost every part of the world, at prices which remove the temptation to make such tools at home. With a fire, a hammer, and an anvil alone, several little odd jobs in the manipulation of iron rods may be done, as instanced by instructions given in my last for making the necessary "rake" used by smiths for their fires. But the smith cannot advance far in his art without the means of holding hot pieces of iron, and then it becomes necessary to provide himself with tools known as tongs. An ordinary pair of "flat bit" tongs, such as those shown at Fig. 26, may be purchased of most tool makers and dealers in metal for a small sum, and with these the novice may practise to learn how to hammer hot iron when held with tongs. This is not so easy as it may seem to the on-looker, for the stubborn little piece of iron seems to have a crooked will of its own, and will not be held by the tongs in a straight and level position on the anvil whilst being struck with the hammer.

The amateur may call in as an aid the use of an oval link, such as the link of a chain, and pass this over the handles of the tongs after the jaws have been made to clasp the hot iron, to keep them firmly in position; but I would advise him to try to do without those aids whilst practising on small pieces of iron, in order that he may get his left hand into training. The use of an oval link will become necessary further on when heavy pieces of iron have to be held with tongs whilst being hammered.

By the aid of the first small pair of "flat bit" tongs, other and larger forms of this useful and necessary tool may be made; the general method adopted in all cases being as follows,—modified as to size of material employed, by the required size of the tool:—Take a rod of $\frac{5}{8}$ inch iron and cut off, with a cold chisel, two pieces, each two feet in length, for the handles. Heat one end of each to a white welding heat, and draw down about three or four inches of the ends to a taper from $\frac{5}{8}$ inch to $\frac{1}{2}$ inch, and round them smooth for the handles. Heat the opposite ends to a white heat, upset them as shown at Fig. 27, then scarf the two ends as shown, Fig. 28, and lay them aside. Next take an inch square bar of iron and cut off two pieces, each 6 inches in length. These are for the jaws.

If the amateur is not the possessor of a pair of stout tongs wide enough in the jaws to hold a piece of 1 inch iron, he should merely mark the iron at 6 inches, and cut it off 1 foot in length. He will then be able to hold one end of the iron in his hand whilst he works the other end, and he can first hammer down a shoulder at one end, and having cooled this, proceed to hammer down the other end, as shown at Fig. 29, before he cuts the iron in two. The two ends of the two pieces intended for the jaws, must be heated and forged down to the following dimensions:—Length 4 inches, width $1\frac{1}{4}$ inches, thickness $\frac{3}{8}$ inch. The remaining ends of the two pieces must then be heated and hammered to form a flattened piece of iron $\frac{1}{4}$ inch in thickness, rounded for the pin of the joint, as shown Fig. 30, and then drawn down to a slightly rounded taper, as shown Fig. 31. Heat those parts again, and punch the pin holes with a taper iron pin or steel punch, the required size, in the position shown by the dotted lines at Fig. 31.

The pin, Fig. 33, is merely an iron rivet $\frac{3}{4}$ inch long by $\frac{3}{8}$ inch in diameter. To make this rivet, take a piece of $\frac{1}{2}$ inch iron rod, heat the tip to a white heat, and lightly hammer $\frac{1}{2}$ inch of the tip down to a $\frac{3}{8}$ inch taper. Next get a piece of flat iron with a $\frac{3}{8}$ inch hole in it, and lay this on the anvil. Then nearly—

but not quite—cut off 1 inch of the tapered tip, as shown Fig. 34. Heat to a white heat, thrust it quickly into the hole in the flat piece of iron, twist it off from the rod, place the iron over the hole in the heel of the anvil, and hammer the hot iron into the hole. The large part of the hot iron will not enter the hole, but will flatten out into a button, and this must be rounded with a few light blows to form the head of the rivet, which can then be turned out complete.

In furnishing the smithy with tools, we shall have to make a rivet and "nail former" perforated with various sized holes, but any chance piece of flat iron with the required size hole in it, will serve our purpose now. The hole in the tongs for the pin should also be $\frac{3}{8}$ inch, and may be made with an iron punch with the point tapering from $\frac{1}{4}$ to $\frac{1}{2}$ inch, as shown in Fig. 35, or a steel punch may be made to the same form out of $\frac{5}{8}$ inch round or square tool steel ; the latter, is, of course, preferable, as it will rank as a tool for the future. The position of the hole should be marked with a centre punch or other sharp pointed tool before the iron is heated, and the heated iron placed over the hole in the heel of the anvil whilst the hole for the rivet is being formed. When the parts of the tongs have been all formed as directed, we will proceed to put them together in the following manner :—Heat and scarf the taper end of the piece, Fig. 31, to fit the scarf on Fig. 28. Now place the two scarfed ends into a good clear fire and heat them up to a welding heat, then throw a little clean fine fresh water sand on them, and continue to heat until they appear pasty, then quickly withdraw them to the anvil ; place the two scarfs together, give them a few light taps with the hammer to stick them together and carefully return them to the fire. Heat up again for a few moments, then return to the anvil, and finish welding. Again return to the fire, heat to a red heat, and forge down the parts as shown, Fig. 32, so as to gradually blend the squared part with the round handle, and give the necessary rounded contour to the reins of the tongs. Finally, heat the rivet to a red heat, place the two parts of the tongs together on the anvil and rivet them lightly together ; then heat up the jaws and set them to the required width. Smiths rarely make a special rivet for tongs. The usual practice is as follows : Take a piece of $\frac{3}{8}$ round iron, heat and nick it the required length for the rivet as shown, Fig. 34 ; place the two parts of the tongs together, insert the heated pin, twist it off the rod, raise the tongs slightly above the anvil to allow quarter inch of the pin to protrude on the lower side, and rivet the upper part of the pin ; then quickly turn over and rivet the other side. When riveting the pin in this way the tongs are liable to be fixed firmly, because the hot iron swells and fills the hole. If this happens, do not attempt to open the tongs whilst cold, but return them to the fire, heat the jaws and pin to a bright red, and then gently try to open them ; work them to and fro for a short time whilst hot, then take them to the anvil and finish setting the jaws as required.

The jaws may be easily sprung wider apart by inserting a piece of cold iron into them whilst hot, and giving them a few light blows with the hammer on the anvil. The amateur smith may not be able to give such a finished appearance to the weld on his tongs as he would desire—this is attained by professional smiths by the aid of tools named swages, to be described further on ; but he should try to finish the parts neatly with hammer alone, bearing in mind that the work of old time smiths, now so much admired, was done without the aid of such accessories as swages.

The "flat bit" tongs just described, may be regarded as the parent of all other forms, which can be easily constructed in the same manner, with a little variation in the form of the jaws after the tool has been brought to the stage of its manufacture, shown at Fig. 32. An elongation of the bit by forging it and then giving the lengthened iron a curved form will produce the pincer tongs, Fig. 36. These may be made to shut close as a pair of pincers, but, for smith's work it is preferable to have the ends of the bits notched with angular notches as shown at Fig. 37. These are preferable to round notches, because they will do equally to hold round or square bars. The special use of pincer tongs are to hold rivets and bolts, and other pieces of iron having a projection at the end. They are therefore useful tools, and are made in various sizes to suit various weights of work. A further elongation and a varied curvature will give the "hammer tongs," Fig. 40. These are used, as the name implies, for holding hammer heads and other similar pieces of iron having holes in them ; a more or less curvature being given to the bits to suit the kind of work in hand.

Still another departure is shown in the "crook bit" tongs, Fig. 39, in which it will be seen that the bits have been elongated as for pincer-tongs, then bent on one side at right angles. These are used for holding thin hoops, discs and plates of metal ; also for grasping the edges of vessels being lifted out of a furnace or fire. They may be given a rounded form if so desired, and are then better adapted to grip discs and plates of metal. Small pairs of "flat bit" tongs may have their bits elongated and shaped as shown, Fig. 38, to make the ordinary smith's "pliers" or light tongs for small work. These may be further thinned out and curved similar to pincers to form crucible tongs, useful for handling hot crucibles and pots of

molten metal. In this way many varieties of tongs may be made in turn out of a pair of flat bit tongs. Heavier tongs, from 2 feet to 5 feet in length, must of course be made of stouter iron ; and it will be well to be provided with several handy varieties to suit various kinds of work, instead of having to alter the tools. A useful accessory for heavy work is shown at Fig. 41. This is simply a link of a chain, large enough to slip over the handles of the tongs, and is so used when the weight of the iron would render it liable to slip out of the tongs and overcome the strength of grip of the smith's hand.

If now the novice has been able to turn out of hand a decent "rake" and "slice" for his forge, and also a decent pair of tongs, he may proceed about other work with some confidence in his ability to "draw down," "upset," "scarf," "weld" iron, and forge it. Indeed, the man who can turn out a good pair of tongs may be trusted with almost any job in the smithy. But he should always avoid conceit, and it will be well here to warn him that iron from various makers varies in its quality and composition, and a slight variation in the quality may lead to such failures as will entirely take the conceit out of him. The fire, too, will get "dirty," that is, after doing several welding jobs, the small cinders will become charged with small particles of iron, and these will fuse together, forming clinkers. These must be raked out of the fire from time to time, and the dirty cinders cast back on the hearth of the forge. Then again the fire may get dirty from using dirty iron, such as galvanized or tinned iron, and also from having tinned vessels put on the fire or soldering bolts heated in it. Dirty coal will also spoil a smith's fire, that is coal containing "brasses" (sulphuret of iron) shale, slate and other earthy matter; the smith should therefore be careful to get good clean bituminous small coal and specify that it is to be used for smith's fires. Again I would warn the novice against assuming that he can work steel because he has made himself acquainted with good iron. Steel behaves in a different manner, when heated, than iron does, and it requires a little experience before steel can be successfully forged and welded. In my next paper I hope to give instructions on how to make some steel tools for the smithy, when we shall learn something about this material, but at present we will deal with iron.

Mending a Hoop.—Most of my readers know how easily a boy's hoop is broken, and may imagine that it can be as easily mended. Opportunities of testing our skill in this direction will not be long wanting, for broken hoops are always plentiful in the hoop season. Heat to a white heat and upset one of the broken ends at a time, then scarf them, one scarf on one side, the other on the opposite, as shown Fig. 42, then heat up, cast in a bit of clean sand, and when hot enough, fetch out quick to the anvil, hold the lower scarf on the anvil with the hammer, quickly place the other or uppermost scarf on this firmly with the left hand, close up the parts and weld. Heat up again and nicely round the weld on the back of the anvil. Allow the hoop to cool gradually before returning it to its owner.

Making a Staple.—The common staple, Fig. 43, is often required in various sizes and for various purposes on farms, gardens, and outbuildings. Select a rod of iron, the desired size of the staple, heat one fourth of the length required to a welding heat, draw out to a tapering point with square sides, cut off the required length, fix the taper end in a pair of flat bit tongs, with a link over the handles, heat and taper this end, then heat the middle part to a red heat, bend it over the beck of the anvil, unloose the tongs and shape the staple up on the anvil. If a small staple, shape it over a piece of round iron held in a vice. In a well furnished smithy, we may find a small anvil for the purpose, made to fit in the swage hole of the large anvil; this is a useful tool which I shall describe further on when treating of swages and fullers.

Making a Hasp.—The hasp, Fig. 44, is also largely used, together with staples, as a fastening for gates and doors of outbuildings. The usual length is 6 inches over all. Take a piece of ⅜ iron rod, mark off 12 inches, by slightly nicking the spot with a cold chisel. Heat up the tip of the rod to a welding heat, upset, and make a short scarf. Then bend 3 inches over the beck of the anvil to form the loop for the padlock, as shown Fig. 45 ; heat the junction to a welding heat and weld together. Next cut off the required length, form a small eye at the other end in a similar manner, then heat and bend it to the required shape. Another form of hasp, Fig. 46, is made by simply doubling a 12 inch length of iron, welding the two ends together, and shaping the hasp up, as shown in the figure.

Holdfasts.—Holdfasts, such as those illustrated at Figs. 47, 48, 49, 50, are frequently in request both in town and country. The form, Fig. 47, is used to fasten a post, or the end of a partition to a wall. To make this, get a piece of ⅝ or ¾ inch square bar iron, heat up one end to a welding heat and draw out the spike of the holdfast to the required length, then cut it off. Fasten on a pair of flat bit tongs to the spike, heat the blunt end to a welding heat, and flatten it out on the inner edge of the anvil by striking it on one side only; this will press the plastic iron down by the edge of the anvil, and form the shoulder, as shown in the figure. Round up the flattened part whilst the iron is hot, return to the fire and heat to a

red heat, then punch the hole, using an iron nut for a bolster. The form, Fig. 48, is commenced in a similar manner, but the blunt end is drawn out into a long, thin strip of iron instead of being flattened, as in Fig. 47. This strip is afterwards bent, as shown in the figure, to grasp a round bar or pillar. The form, Fig. 49, is used as a support to water channels or gutters placed under the eaves of houses. It is formed by first making a spike, as shown in the figure; then the required length of flat bar iron to form the curved part is heated in the middle and upset; this part of the blunt end of the spike is then heated to a welding heat, and welded together. Sometimes a hole is punched or drilled through both pieces, and they are then riveted together. The form, Fig. 50, may be made out of round or square bar iron, in a manner similar to that directed for Fig. 47, and is used for a similar purpose. All these forms are made and used in various sizes. The smaller sizes, are, of course, made out of thinner iron, and the holes in them have to be drilled instead of being punched.

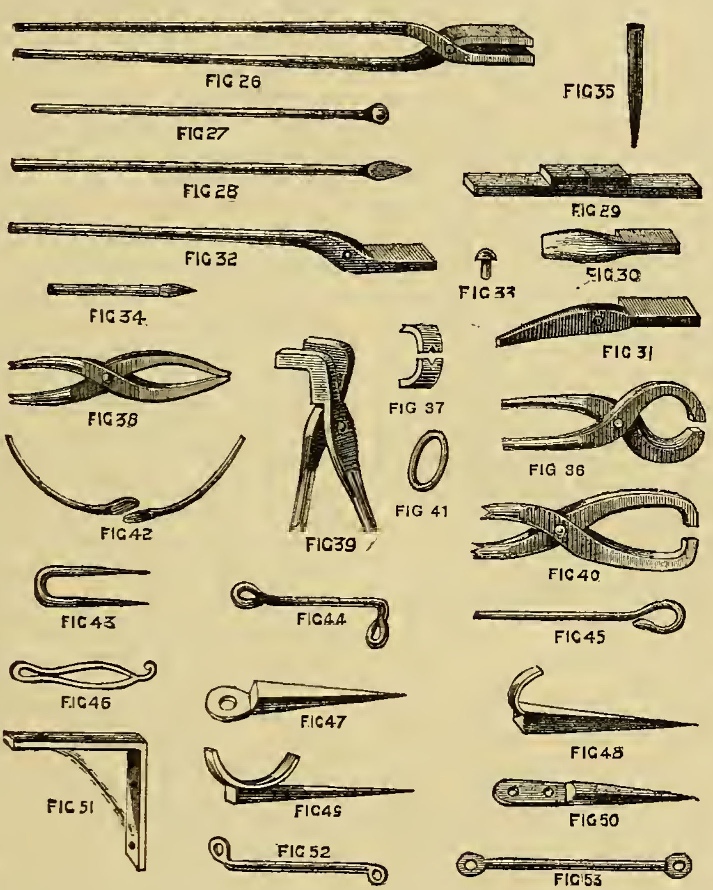


FIG. 26.—FLAT BIT TONGS. FIG. 27.—ROD FOR HANDLE OF TONGS, UPSET AT ONE END. FIG. 28.—SCARFED END OF ROD. FIG. 29.—BITS OF TONGS FORGED ON BAR OF IRON. FIG. 30.—BIT HALF FORMED. FIG. 31.—BIT FORGED AND TAPERED. FIG. 32.—HALF OF TONGS COMPLETED. FIG. 33.—RIVET. FIG. 34.—IRON FOR RIVET. FIG. 35.—PUNCH. FIG. 36.—PINCER TONGS. FIG. 37.—NOTCH IN JAWS OF PINCER TONGS. FIG. 38.—SMITHS' PLIERS. FIG. 39.—CROOK BIT TONGS. FIG. 40.—HAMMER TONGS. FIG. 41.—LINK. FIG. 42.—PART OF BROKEN HOOP SCARFED FOR WELDING. FIG. 43.—STAPLE. FIG. 44.—HASP. FIG. 45.—LOOP OF HASP. FIG. 46.—BOW HASP. FIG. 47.—HOLDFAST. FIG. 48.—HOOK HOLDFAST. FIG. 49.—CRUTCH HOLDFAST. FIG. 50.—PIN HOLDFAST. FIG. 51.—BRACKET. FIGS. 52, 53.—STAYS.

Brackets.—The ordinary iron bracket shown at Fig. 51 is mainly used as a support for shelves, and as a stay to angles of wood-work. It is easily formed by heating the required length of flat bar iron to a red heat, and bending it sharp over the outer edge of the anvil. The required holes may be punched or drilled. The sizes in general use are made out of $\frac{5}{8}$ by $\frac{3}{8}$ inch, and $\frac{1}{2}$ by $\frac{1}{4}$ inch bar iron. Large brackets for stays should be made out of stouter iron than this. It sometimes happens that a simple stay, such as that shown at Fig. 52, is alone required to a shelf. This is made out of $\frac{1}{4}$, $\frac{3}{8}$, or $\frac{1}{2}$ inch iron rod in the following manner: The necessary length of iron is cut off, heated at one end to a welding heat, and flattened to form a rounded foot as shown; this is then punched to form a screw hole, and the other end is similarly treated, as shown Fig. 53. The two ends are then heated, and bent to the desired angle. Light brackets, such as those shown at Fig. 51, are sometimes strengthened by a light stay of this kind, welded to the bracket, as shown by the dotted lines in Fig. 51. This is easily done, after the feet of the stay have been made. Many other forms, sizes and lengths of brackets and stays might be illustrated, but these will suffice to show how all may be made.

General Remarks on Drawing Down.—Always heat the iron at first to a welding heat, and slightly upset the end with a few light blows of the hammer, to close up possible flaws made in cutting the last length off. This precaution is specially applicable to small rod iron. If the end has to be drawn out to a taper point, the blow from the hammer must be made to curve towards the point at each stroke, and the hand of the workman must be trained to push the

hammer at the finish of each stroke towards the point or desired point of the iron. If the heated end has to be simply flatted out, lay it on the centre of the anvil face, and strike it with level direct blows. If it has to be flattened on one side of the bar only, whilst a shoulder has to be left on the other, lay the hot iron on the edge of the anvil only, merely turning it on its edges now and then to shape these as the work proceeds. Direct the blows of the hammer to the side of the iron it is desired to flatten out, and make the hammer push the plastic iron where it is wanted. Do not hammer the iron when it is cool, and be careful to take only a quarter turn in finishing off squared taper points. Special attention must be given to this when tongs are used, or the result will be split points. Learn also to hold the tongs in a direct line with the work, and at a level with it on the anvil. Unless this is done, the heated iron will appear to play various pranks on the anvil, and perhaps part company with the tongs altogether. Keep the tongs as cool as possible, by dipping them in the water trough just before taking the work from the fire. Also keep the temper cool under difficulties and disappointments.

(*To be continued.*)

PRACTICAL SCENE-PAINTING FOR AMATEURS.

By HENRY L. BENWELL.

XII.—DESIGN FOR SCENE, SHOWING PAINTING AND ARRANGEMENT OF A SHIP'S DECK.

AS a general rule, in country theatres, scenes of this description never really look what they are intended to represent; they are generally made up with a conglomeration of old flats, and odds and ends from the scene dock. These are painted accordingly, as they lend themselves to their new use, and the result is that the illusion is far from perfect. This is a mistake, as a "set" of this description always repays the trouble and expense bestowed upon it. Ship scenes are required in several well-known dramas and operas, and there is hardly a pantomime that can do without them. Thus it will be seen that the painter is often called on to paint this subject.

I have endeavoured in the accompanying drawings—which are original designs—to present a scene which is easy to paint, and I think, when set, would prove effective, and nearly perfect as regards illusion. I have in the drawing, perhaps overcrowded the stage with set pieces and properties, but these can, of course, be reduced in the event of the stage being small, or a good many characters taking part in the play. Take the comic opera of "H.M.S. Pinafore," for instance, in which so many supers appear, and so much room required on the stage. To set a scene for this, the hatchways would be dispensed with, and the mast, perhaps, set behind the "bridge," the latter on a small stage being made "practicable" and solidly built, in order to accommodate the chorus. Other characters should be seen through the gangway on a sort of afterdeck (as Fig. 66, backing). This leaves the stage clear for the principal performers. On the other hand, if the stage be large, the design may be added to and rendered more effective in several ways.

I will now attempt a description of the drawings, and explain the making and "setting" of the scene in as few words as possible.

The back cloth—the painting of which was touched on in the last chapter—is an expanse of sea and sky, and should be hung up the stage as far as possible; the deeper the stage the better for this scene. About ten feet in front of the "cloth" is fixed the "practicable" bridge, Fig. 61. At A in this figure is an opening for entrances and exits—this is a gangway. In Fig. 61 it will be noted that the sides and top of this gangway are really painted on the frame in *stage* perspective, and that A only is the real opening. This, if cleverly painted, should have its desired effect; but below this drawing I give an alternative plan which I think looks most effective and also assists the carpenter in building the bridge. Figs. 62 and 63 are two separate frames, slanting at top, and painted *as regards perspective in the same way* as Fig. 61. The roof, Fig. 64, is made of wood, and painted inside with a dark shade of any odd colours. The roof and sides are then fixed together, and to the bridge at B, B. It will thus be seen that the opening is now at B, B, and twice as wide as that at A in the first plan.

The doors in the gangway may be made use of if required; but this will hardly be found necessary. Leading on to the bridge are shown the "property" steps or ladder, B, Fig. 74, and beyond the "practical" wheel, Fig. 65. This latter "prop." is made of wood, and painted by the artist. It should be made well. Fig. 66 is the backing to the gangway A (Fig. 61), and is a raised platform about 1 foot high, with a painted frame at the far end representing the stern of the vessel, and from which a flag, F, is seen flying. The doors C, C, Fig. 61, are also "practicable," behind which backings (Fig. 67) are placed to screen the cloth at back. *All backings to be twice the width of the opening they are intended to cover.* The *right* side of the set is shown at Fig. 68, the loop holes D, D, being, of course, cut away for insertion of cannons. Care must be taken that the loop holes come between each pair of horizon wings when the

whole is set. The left side is painted as regards shading, etc., just the reverse to the right, and of a lighter colour, this being the lightest portion of the picture. Fig. 69 is a specimen border, several of which will be required; these may either be painted, or may be the real thing, *i.e.*, canvas tacked on the battens, and arranged in folds and looped up with cord.

The mast, Fig. 70, is best as a property. It is made the same way as a *drum roller*, but slightly tapering, covered with canvas and afterwards painted. We cannot now describe the roller, as it is the carpenter's work, but at Fig. 70 is shown a flat board, cut in profile, canvassed and painted in true perspective to give the necessary rounded appearance. This last device is simplicity and cheapness combined, whilst, on the other hand, the *drum roller* principle, although expensive for amateurs, lends itself to the greatest effect. I need hardly point out that a solid pole of the size required would be too heavy to work with comfort on the stage, especially if the space be cramped. The mast will look better if some wooden rails (painted) are set round it (Fig. 71). The ship's guns, Figs. 72, and the capstan, Fig. 73, should properly speaking, be "properties" made by the carpenter, of wood, and painted so cleverly as to really look like the true article. Amateurs and managers of small theatres can hardly be expected to go to this expense, however, so I give in my drawing the method of painting these on *profile* frames.

If these "set pieces" are painted boldly in good perspective, and with true colouring, they also can be made to look almost as effective as the *property* article. In future papers relating to the stage, I hope to show how to make these frames, put them together, cut out the profile, etc., and show the *back* as well as the front of everything. But now I write for the painter only. I must, however, point out that the bottom of all frames for set pieces must be straight, to rest perfectly firm upon the stage, so that after the object has been painted on in stage perspective, the space that intervenes between the object and the bottom of the frame should be filled in with black colour, as at B, B, B, B, Figs. 72 and 73. This device will be found to answer admirably in a great many cases. My drawings being in black, however, do not show up so well as they would were the objects coloured like the set piece itself; but I can assure my readers the black space at the bottom is not noticed by the audience at all.

I have not space sufficient to make separate drawings of the hatchways, A, A, Fig. 74, but I think they speak for themselves. They are made of canvassed frames, with tops made of profile; the doors are also frames. These are painted both sides, as shown, both being *practicable* and placed over trapdoors on the stage. The tops are made in halves, the front half sliding back over the other portion. Unless the doors have to be closed or opened during the progress of the play, the front half may be dispensed with and the doors "set" open. One "set piece" like this will, no doubt, be sufficient, and this must, of course, be where the trap is situated on the stage. In speaking of the wheel, Fig. 65, I forgot to mention that it is fixed by means of stage screws running through the iron plates (E E) of the supports, and that an iron pin runs through the centre of wheel, fitting into holes in top of supports.

In Fig. 74 is depicted the scene "set ready" on the stage, and I think with a few explanatory remarks will be readily understood. The point of sight is the capstan, exactly in the centre of sketch, and in "drawing in" each portion of the scene this must borne in mind. Each piece must be drawn in perspective, and all lights and shades of colour well considered, so that when all is fixed it shall form a picture, perfect in drawing, light, and shade. All this requires forethought and practice, if not actual experience.

As regards the painting and shading, we will suppose the sun is to the left of the *sketch* (*the right side of the stage*), or, more plainly speaking, south-west, and is getting low. The set piece on the right of the stage must be painted in shadow, except the sides of port-holes through which the light streams on to the guns. The guns must be painted with their lights and shadows to aid this effect, and care must be taken by the artist to mark them on the back with a big "R," or "O. P.," or, much to his chagrin, he will find them set all wrong by the stage men, unless he is there to superintend, which alters the case; nevertheless, *he must mark each and every piece to show where it is to go*. The shadow from the ship's side is also thrown on to the bridge set, on the right. On reference to the sketch it will be seen that I have been compelled to place the mast somewhat out of the centre in order to show the ladder and wheel set in their proper places, the proper place for the mast, however, is at the centre C, and when standing there it would throw a shadow on the bridge as shown. I need hardly say that to make a perspective and detailed drawing of a scene like the one now under consideration, as it appears on the stage, is no easy task, and as it is I cannot show it all. Scene-painters get out of this difficulty by making cardboard models, and exhibiting them to their managers on an exact model of the stage of the theatre. Speaking of models, one would have to be made of this scene by the artist before he commenced work. This must be drawn to scale as the carpenter will want it.

Suspended from the mast by four ropes and

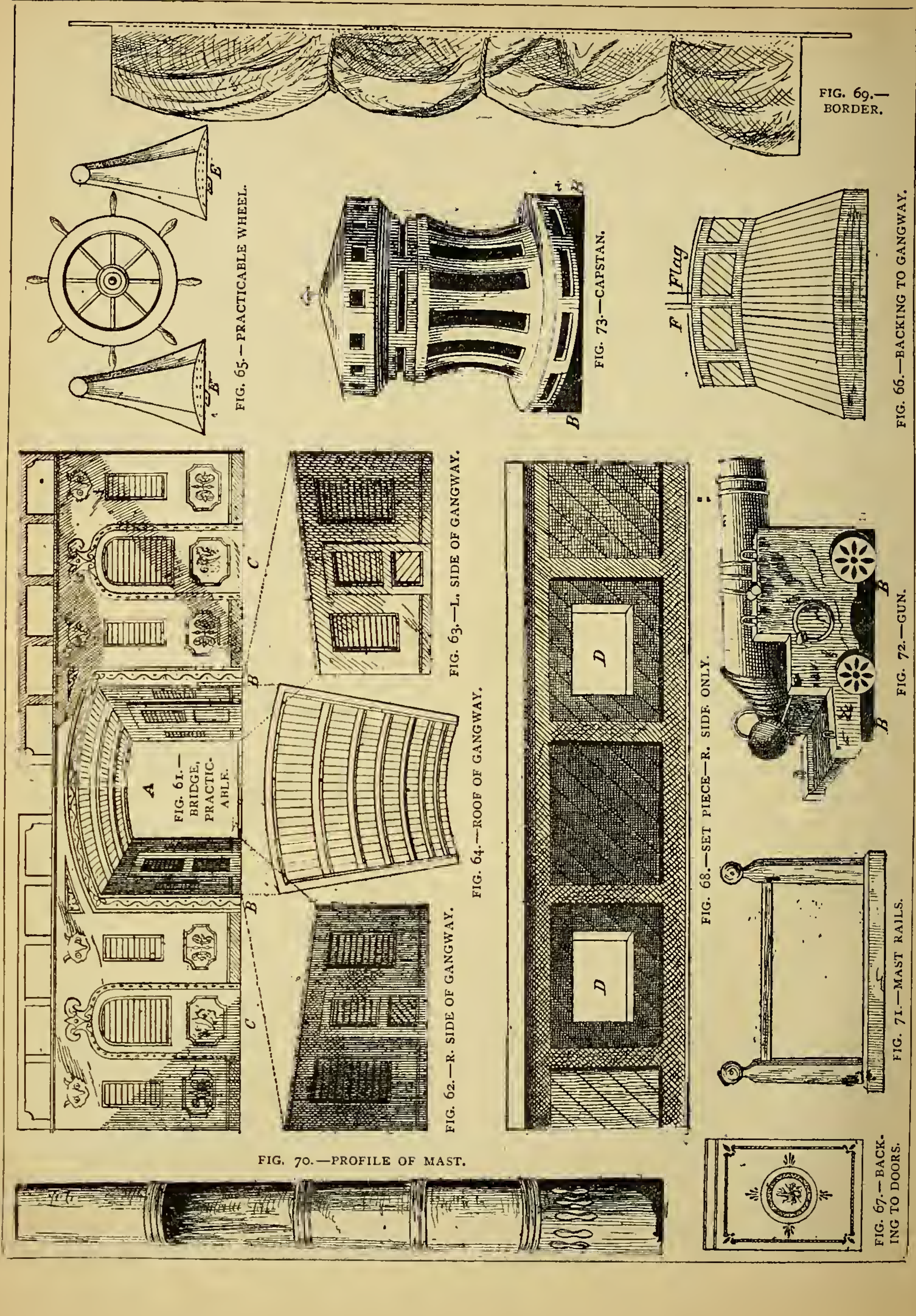


FIG. 61.—BRIDGE, PRACTICABLE.

FIG. 62.—R. SIDE OF GANGWAY.

FIG. 63.—L. SIDE OF GANGWAY.

FIG. 64.—ROOF OF GANGWAY.

FIG. 65.—PRACTICABLE WHEEL.

FIG. 66.—BACKING TO GANGWAY.

FIG. 67.—BACKING TO DOORS.

FIG. 68.—SET PIECE—R. SIDE ONLY.

FIG. 69.—BORDER.

FIG. 70.—PROFILE OF MAST.

FIG. 71.—MAST RAILS.

FIG. 72.—GUN.

FIG. 73.—CAPSTAN.

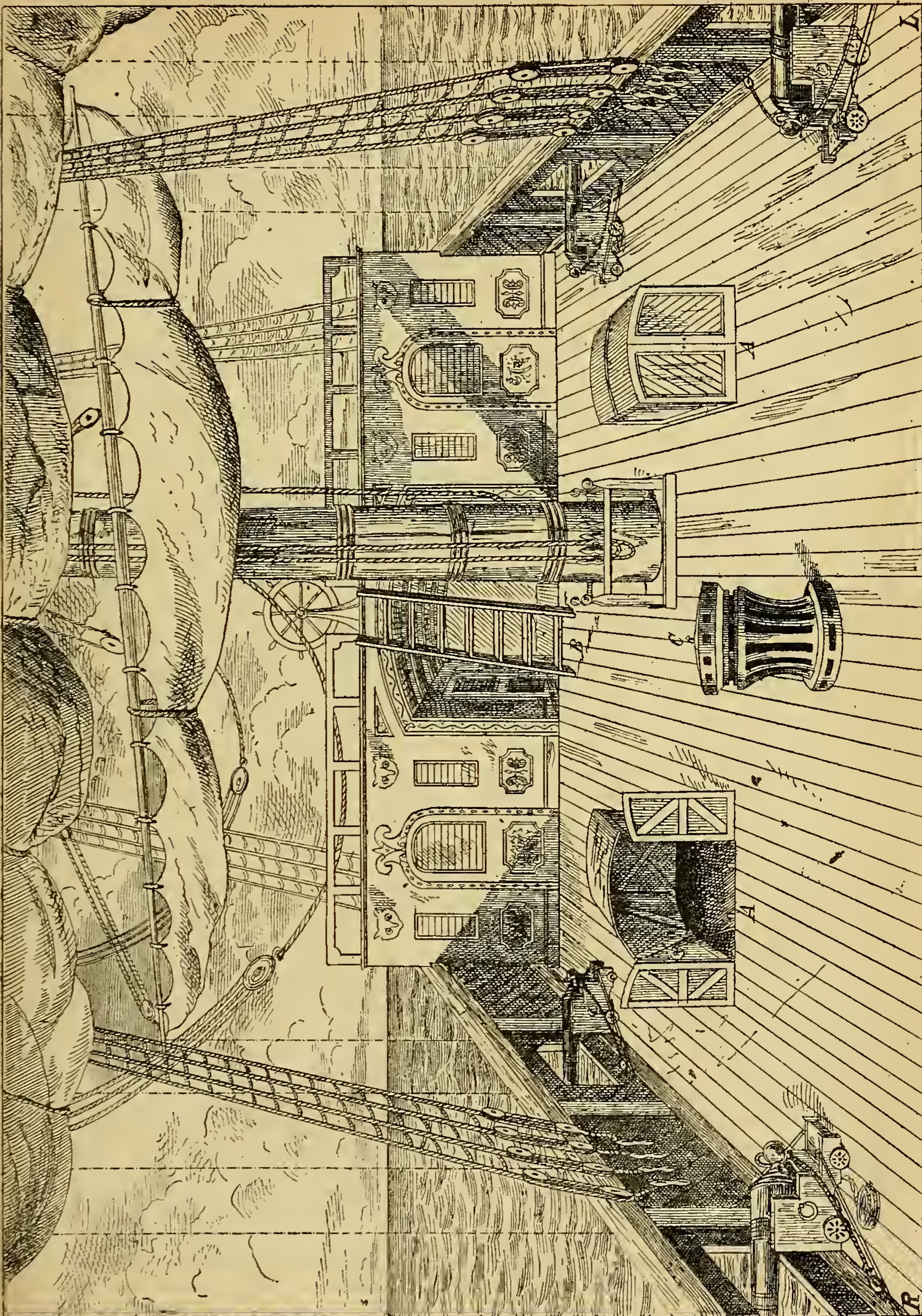


FIG. 74.—DESIGN FOR SHIP'S DECK, SHOWING SCENE SET READY ON STAGE.

pulleys is a "property" spar, rings, and folded sail, this hangs just below the border, and throws a slight shadow on to the bridge on the left. I have not given detailed drawings of the scrolls, mouldings, and relievo heads on the "*bridge*," because most artists will have plenty of working copies and stencils to make use of. I can, however, make some if required. A strongly-built platform behind the bridge for the "man at the wheel," and other supers, will be left to the carpenter. The wheel is shown in its place, with the ladder leading up to the same. The gangway backing I leave out, as only a portion would show, and that very faintly. The hatchways are duly placed over the traps, and the capstan well down the stage in the centre. I spoke in the last chapter respecting horizon wings, dotted lines each side of the sketch represent these, the horizontal line being the same as that on the back cloth. Four wings are shown on each side; there are, besides these, the proscenium wings. The rope ladders, pulleys, and cords are not painted but real, so are the chains and ropes to guns; the ropes that hang down from the mast, and also the other ropes and pulleys that are seen hanging across the stage. All these should be arranged naturally, and fastened to the wooden pegs (I forget the technical name of these for the moment) that are fixed to the mast and sides of the vessel.

A man is seen working the vessel at the wheel; on the bridge are some deck-chairs, with officers and passengers sitting in them; through the gangway can be seen sailors at work on the after deck, hauling up ropes, tightening sails, and going through other routine duties. Near the guns are laying neat coils of rope. A wrap, or coat, and ropes are lying or hanging on the mast rails. About the stage may be placed old flags and bits of canvas, rifles standing in corners, cannon balls, boxes, casks, and other consignments. All these, and other features, may be presented as the curtain rises, in order to present a picturesque and truthful view, and may be afterwards gradually cleared off by "supers," supposed to be carrying goods below, etc., etc.. All this is seen to by the stage-manager, but he often consults the artist, and so I give these suggestions here.

It is the practice with some artists to paint the sides of the vessel on the horizon wings, and the actors are seen to rush on and off from these wings and come out of the sea, as it were; nothing looks more absurd and so completely spoils the illusion, and yet this is done even now, at large theatres. In my design I prevent all this, and allow plenty of natural entrances and exits—*i.e.*, two doors to deck cabins under the bridge, under the gangway, and down the hatchways, into the saloons below. I never painted a scene exactly like the one just described, but once did a "set" not quite so elaborate. In this I dispensed with the horizon wings entirely, but painted a continuous horizon "cloth," which ran round the sides and back of the stage, and was placed some distance from the "ship's set." With a row of ground lights all round to light up the "cloth," I achieved—so my manager told me—a great success. Later on I hope to describe a mechanical method of working this scene, in order to give the effect of the ship rolling, and another method where it eventually sinks into the sea, These effects are the invention of Mr. Oliver L. Tweddle, principal artist of the Theatre Royal, Reading. (*To be continued.*)

HOW I MOULDED A CURTAIN POLE TO MY BAY WINDOW.

By NEPENTHE.

IN the authorities for amateurs within my reach, they are told that "*moulding curtain poles*" is a job that they "*had better leave to the professional cabinet-maker.*" I venture, however, to describe a method by which very fair results are attainable.

Fig. 1 shows an outline of a "bay," and the points F, F, F, where the usual brass fixtures may be affixed to the wall. These points I chose should be $3\frac{1}{2}$ inches below the lower margin of the cornice, and about midway of each section of the bay. When secured, I let fall a plumb-line from the centre of the concavity in which the pole was to rest, to the floor, and marked its distance from the skirting. Through this point I drew lines parallel with the skirting, crossing each other at A, A, A, A.

With the point A as a centre, Fig. 2, I described upon the floor the arc of a circle, B, H, B′, giving the equal radii A B and A B′. With the centres B and B′ I then described the arcs C D and C′ D′, intersecting at G. By connecting A and G with the straight line A E, I divided the angle B A B′ into two equal parts, and by setting my bevel accurately to either of the equal angles B A H or B′ A H, obtained a guide to the first saw-cut through the pole. Marking the direction of this cut as carefully as possible upon its convexity, I sawed by eye, correcting any deviations from the desired angle by laying the two pieces upon the floor lines shown in Fig. 1, and using the smoothing-plane judiciously.

When a proper joint was obtained, I centred each oval face by drawing lines at right angles through the narrowest and longest dimensions, and fixing the pieces in a vice, bored them longitudinally with a $\frac{5}{16}$ inch Jennings' bit, making holes about 3 inches deep in each.

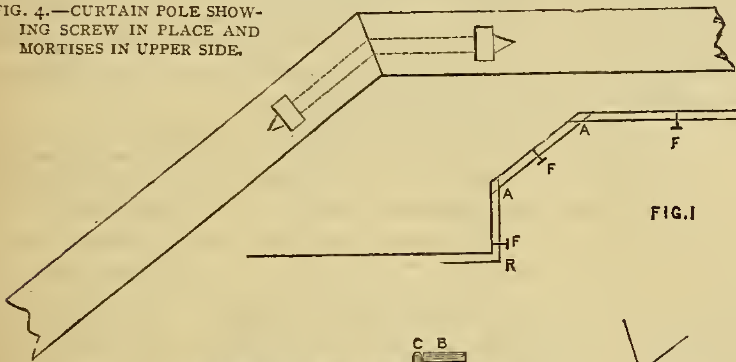
Having previously obtained some "stair-rail

screws," shown in Fig. 3, which are 4 inches long, by a little less than $\frac{5}{16}$ inch through, I removed the nuts and washer, heated them to welding heat, and bent them in a vice at their middle, using gas-pipe pliers for handling them when heated, lest the ordinary pincers or tongs should spoil the threads. When thus bent and adapted to the angle B A B′, they were ready for application to the pole joint already made, and fitted accurately the holes bored, allowing close application of the oval faces, as shown in Fig. 4. The proper position of the mortises which were to receive the bent screws, it being almost impossible to secure a *perfect* angle when bending them at great heat, and with such appliances.

When all the outer joints have been thus made and fastened, trials upon the floor should be made to secure the *general level* of the various sections, and to prove their several lengths to be correct. The joints may then be loosened, glued and refastened, the screw-driver being assisted with gentle taps of the hammer at their final closure.

The inner or rectangular joints—I mean those at R, R, in Fig. 1—cannot be fastened by stair-rail screws (bent at right angles), unless *circular* nuts are used in each mortise. A less troublesome way I found in using a 3 inch common wood screw, well countersunk, with a small dowel by its side to prevent any twist from the weight of a curtain.

FIG. 4.—CURTAIN POLE SHOWING SCREW IN PLACE AND MORTISES IN UPPER SIDE.



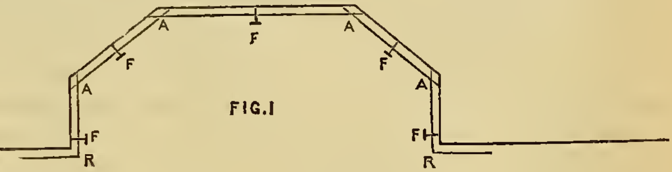


FIG. I.—DIAGRAM SHOWING PLAN OF BAY WINDOW, WITH INTERSECTING PARALLEL LINES.

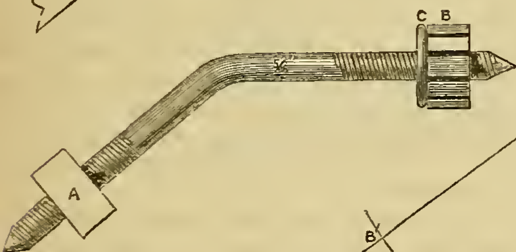


FIG. 3.—A STAIR-RAIL SCREW, BENT.
A, Square Nut.
B, Circular Nut.
C, Washer.

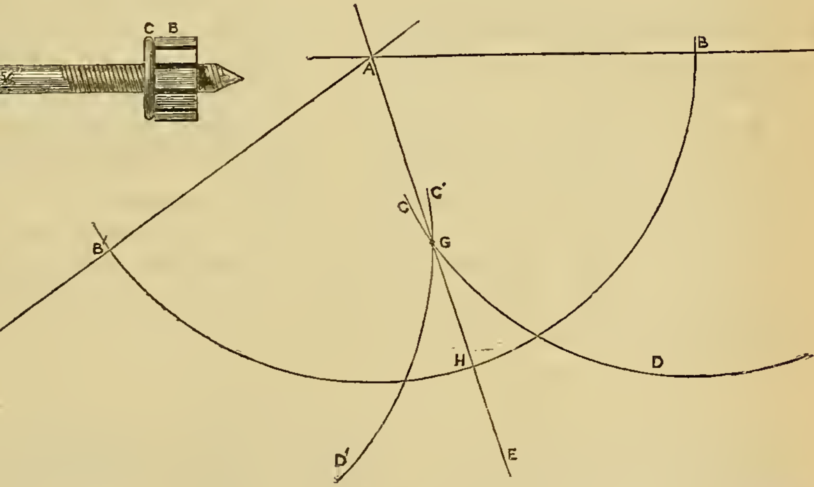


FIG. 2.—DIAGRAM SHOWING HOW TO OBTAIN PROPER BEVEL FOR CONNECTION OF PARTS OF POLE.

the nuts being then marked off, they were cut with a $\frac{1}{2}$ inch chisel, one with a square bottom, the other rounded to fit the nuts easily.

The square nut being dropped into place, and one end of the screw fastened in it, so far as that its angle entered the wood $\frac{1}{8}$ inch, the other piece, with circular nut and washer in its mortise was adjusted, and by help of a screw-driver applied in succession to the grooves cut in the circumference of the nut, the pieces were brought into close and firm apposition.

If the joint be unsatisfactory, it will be requisite to pare the orifices of the borings at the *inside* of the angle, to conform them more exactly to the shape of

The mortises (always on the *upper* side of the pole) and screw holes may now be puttied with red putty, the joints smoothed and stained if necessary, or varnished with shellac, and the ornaments added.

All rings required upon the *moulded* part of the pole, *must be put on before the rectangular joints are finally fastened.*

OVERGLAZE PAINTING ON PORCELAIN.

By AURELIO DE VEGA.

XIII.—FLOWERS—FIRING.

226. I HAVE already given, in Chapters V., VI. and X., some notes as to procedure in flower studies. Those were specially adapted to the work then given. What follows will partake more of the nature of general instruction applicable to flower pieces in colour.

227. *Flower Brush.*—And here I wish to notice a kind of brush which of late has come, and deservedly so, largely into use for flower painting, to which it seems peculiarly suited. It is not a flat brush, neither is it exclusively round, like those shown in Figs. 6 to 12, but is a most happy combination of both. In short, it is a round brush, which may be worked flat. Its patent peculiarity when dry is that its end is not domed as the end of a pointed brush should be, but is quite flat. It must, in that condition, have no protruding hairs. When wet with water it does not form a fine point, but its end is still regular, and not in any degree jagged ; and when pressed down on the glass or the thumb-nail, its end should spread evenly like a fan, but present a fine, perfectly straight edge. The greatest utility of this brush is discovered when working with moderately firm colour. Then the brush, in skilful fingers, seems almost endowed with life, so much can be achieved with it. Flat washes of medium and full tone on small surfaces are most readily made with the aid of the spatula-like pressed end, and lines and points can as easily be taken out with its keen, firm edge. Further, this brush is of great assistance in blending different non-antagonistic tints—say, for example, for a leaf going off. Proper yellows and greens lie separately on the palette ; the ground green is laid as usual ; then the brush is *stroked* on to the yellow, not dipped into or filled with it, but merely drawn over it, so as to receive a coating of the colour on the surface. This is placed in position on the leaf. As the brush is drawn along, of course the yellow on it is transferred to the painting, and a graduation is obtained, which only requires to be gone over again in a second or third stroke of the same brush, now depleted of yellow, for the purpose of fining and toning down—a method of procedure which produces a very fine and soft and subtle effect, and which is an application of the glazing process before firing.

For those who take up flower painting principally, a supply of these brushes in appropriate sizes is well-nigh indispensable—quite so for comfort when once one has become accustomed to them. They are a trifle dearer than the ordinary ones.

228. *Petals.*—The petals of many flowers may be done with practically one or two strokes of the brush ; by which I mean that the general tone of the petal may be so given. Of this kind are ordinary chrysanthemums and many other flowers, mostly single, of which the characteristic is long, narrow petals, as opposed to those possessing more or less sphericity. In all these cases, the outlining of the petals having been carefully and fully done with ink, the hinder ones may be done first, and then those in the front and light be worked up to. By this means the work is considerably reduced, as there is less necessity for, in each case, strictly observing the outline of the particular petal in hand. With a little practice, the brush in the next touch will correct the outline of the first stroke, and so on.

229. In the treatment of *Spherical Petals*, such as those of the rose, much must depend on the purpose of the work. If the work is large and important, and the petals are prominent, each of the fuller ones wil probably require individual attention, and fine toning, shading and finishing. If, on the other hand, the work is small and the petals are not a leading feature, they may be done more simply. Many roses are done with carmine or rose alone, and either the heaviest part is laid first, exhausting the brush towards the light, or the petal is wholly washed over, the light then taken out bodily, and the edges of the paint softened towards it, and strong touches given for the depths. The same treatment may be adopted in other similar petals.

230. *Stamens* should be carefully and cleanly picked out in the first painting. They may either then be painted in when the surrounding paint is quite dry, or left until the second painting.

231. *Shading.*—In the case of white flowers, where the plain ware furnishes the local tint, the shadow may be put in at once. So also may, in general, those delicate graduations into colour which are so frequently found in depressed eyes. In the case of coloured flowers the shading had better be reserved until after the first firing. It is only in the case of the larger flowers, at any rate for a considerable time, that shading can be done well with the first painting.

It will not be unprofitable to emphasize here the doctrine that shading is not merely a deepening or strengthening of the tone, and not always the introduction of obscurity, and nothing more. It may be the latter, and often is ; but more often, and especially in pieces in which there is brightness without a prevailing deep shade, the obscurity is always attended by an influence which glances on from the surroundings. In nothing is this more felt than in bright flower pieces. The hue of every flower is affected by the tint of its neighbour, and of the foliage.

Accordingly, a white may shade any colour, delicately, of course. The great failing of most coloured copies is, that the white shadow and the reflected tints are in general much too strong. Similarly, any colour may take any accidental tone. Thus a yellow may shade brownish from a warm dark neighbour, or greenish from a blue or green one. For white, the most delicate shade is shadow for white. Pearl grey is a very pretty shadow, but must be used sparingly. For partial and delicate modification of the colours, glazing will frequently be found more satisfactory than mixture.

232. *Smooth Leaves.*—Many ovate leaves are nearly smooth, with scarcely any bulging, and much of a tint. It is not wise—independently of the violence done to true artistic feeling—to depart largely from nature, and introduce either irregularity of surface or great variety of colouring as one sometimes sees. In glossy leaves, the shimmer gives an accidental tone, for which tile blue slightly greened, and a greenish grey, made by a judicious mixture of azure and strong yellow—the latter predominating—will be found extremely useful. The latter mixture also is in frequent requisition for the undersides of leaves.

233. *Bulgy Leaves.*—In the case of leaves with simple lateral bulgings, the effect can be given entirely while wet by tipping the brush with colour for the shadow stroke equalizing and working off into the light of the division with the nearly-exhausted brush. The end of a line of shadow may be lightened, if necessary, by a light touch of the brush from which the colour has been worked. An extreme example of a bulgy leaf is that of the primrose or polyanthus. In this it will be found most convenient to give the whole leaf, or a half, as the case may be, a graduated wash, allowing the light to be of somewhat deeper tone than that desired. In the shadow, increased accentuation of the veining may, if requisite, be given with fine touches of a pointed brush used a little sideways. Then in the light the points or patches of bright light may be taken out with the stick or with the brush nearly destitute of colour, but with the hairs firm and coherent with a touch of oil.

234. *The Serrations* of leaves may, if bold, be often done with the strokes which go to form the leaf. If small or in small leaves, they will be painted on with light touches. These, like many other minute details, need not, except on occasion, be photographically correct. Except in leaves strongly in evidence, a few indications of

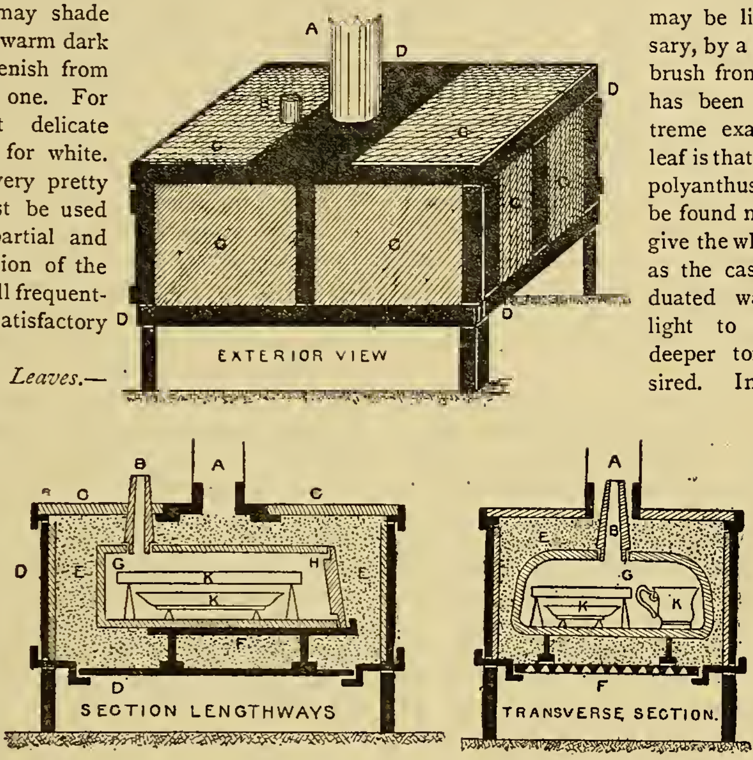


FIG. 59.—THE AUTOMATIC KILN (PYRO-FIXATEUR LACROIX).
A, Flue of Kiln; B, Flue of Muffle; C, Fire-brick Plaques forming receptacle of fuel; D, Iron Bands to hold Plaques in Position; E, Fuel; F, Gridiron; H, Door of Muffle; K, Wares in Position.

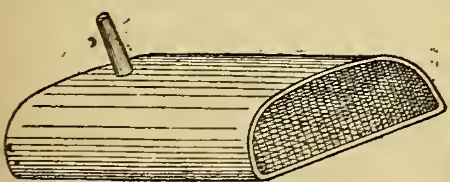


FIG. 60.—MUFFLE NO. 1 FOR FLAT WARE OR LOW ROUND WARE.

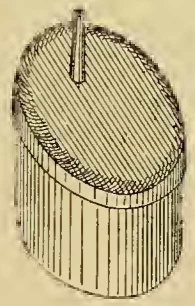


FIG. 62.—OVAL MUFFLE FOR VASES, ETC.

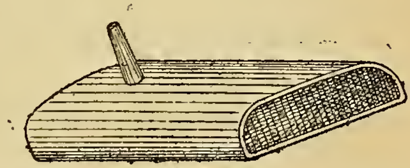


FIG. 61.—MUFFLE NO. 2 FOR FLAT WARE REQUIRING LESS FIRE.

serration will generally be sufficient. A prevailing tint is a reddish brown, most nearly approached by Brunswick brown, to which sometimes a touch of chocolate has been added. It should be of full tone and laid lightly, not on, but touching the leaf colour. Many young shoots are of this colour. Other useful tints are Vandyke brown two parts, German one part, and for a warmer tint, Vandyke with a little carmine.

235. *Flat Leaves.*—Another kind of leaf, with the production of which acquaintance should be made, is that of which the nasturtium is a type. Here we have a flattish leaf, with light veins radiating from a point near the edge. For the first painting give a flat wash which will readily be done with the flat edge of the brush by painting, and crossing and recrossing until the brush marks disappear. Mark the spot with the stick, and with the edge take out the veins ending with defining the spot. In the second painting shade, and, if necessary, glaze.

236. *Flags.*—In Chapter X. I have already given a study of flags. I will here only say that they are a most useful introduction. In water pieces, of which a large class consists of a flag and rush front or wings, a distance, and some feathered life, they form when well handled a very effective as they are a leading item. To be so, however, there must be a mixture of strong erectness with graceful bending, and the general treatment must be broader than for flag flower pieces.

237. *Generally.*—In painting keep with the grain of the petal or leaf, and work in the former from the edge to the eye, in the latter from the edge to the midrib in the direction of the lateral veins, and where these do not exist from tip to stalk. Do not be anxious to preserve this longitudinal vein, in doing the respective halves. In general it is well marked, and of either a lighter or a darker tone than the neighbouring part. In the former case it may be taken out with the fine edge of the brush. In the latter it may be painted on where it does not form a boundary of well-marked shadow.

238. *Choice of Subjects.*—In this connection it should perhaps be noted that for bright and light work as distinct on the one hand from the large and very elaborate studies which may be seen at such exhibitions as those of Messrs. Howell and James, and on the other from decorative work—the best for the beginner are undoubtedly single flowers. Various spring fruit-blossoms—may, wild rose, single dahlias, buttercups and daisies, and a few simple cupped flowers, like single daffodil, or Canterbury bell, are always obtainable in season or from good copies, are easiest to paint, and very often are most effective. Closely-set groups of intricate flowers, and such work as florists' roses, or double dahlias are to be avoided; for these the highest skill is required.

FIRING AT HOME.

239. The present section deals, in compliance with several inquiries from correspondents, with firing at home, and the question of domestic kilns. Two leading London makes—I might almost say one, for they appear practically identical—are so massive and inconvenient, and withal so expensive both in setting up and in subsequent combustion of fuel, as to render them, in my opinion, much less attractive to the amateur than "The Automatic Kiln," of which a description follows. That the use of kilns in the house is a possibility is shown by the extent to which dentists have made use of small kilns, and it is only the question of degree and of the making of a convenient and at the same time practicable kiln that has furnished the very reason why the firing of one's own paintings at home has been so long delayed. This is now obviated by the use of the kiln above named, which may be obtained of Messrs. Lechertier, Barbe, and Co., 60, *Regent Street, London, W.*, and the following remarks are a slight adaptation of the "Instructions for Use," which are sent out with the kiln:—

240. "*The Automatic Kiln.*"—The kiln may be described as a box stove, having external dimensions of length 19 inches, width $13\frac{1}{2}$ inches, height 12 inches. The framework is iron bands, and the sides and top thin plates of fire-brick, the bottom being a grid, and the whole supported by four iron legs. From the middle band on the top rises the flue, which carries off the smoke and gases from the burning fuel, and which may be removed for stowage when the kiln is not in use; and one of the plaques is perforated to afford a passage for the flue which rises from the muffle, and carries off the products of combustion of the volatilized oil from the pieces baking therein. The fire-brick side and top plates—ten in all—fit loosely into grooves in the iron framework. The want of accurate fit in the plates is not of importance. The grid at the bottom is removable, and rests on supports adapted for the purpose. On this grid rests an iron platform, supported by two trestle legs, and on this platform rests the muffle. This is a fire-brick box, which may be had in various shapes, fitted with a door or cover, which entirely takes off, and a loose flue which fits into a hole in the top, and passes through another in the top of the kiln.

241. *Setting up the Kiln.*—The kiln is, as a rule, sent out ready mounted, with the exception of the fire-brick plates, which are packed separately for safety in transit. When, however, the kiln has been entirely taken to pieces, the mode of reconstruction is as follows: On the base place the grid, with the thinnest edge of the bars uppermost; then place together one small and one large side, taking care that the outside corner marks correspond, and that the parts so

marked are uppermost, and fix these sides by means of the pins provided. Proceed with the other sides in the same way. When all the pins are in position insert the fire-brick plates, putting in the large ones first. Then put in the fire dogs.

242. *Preparation for Firing.*—The peculiarity of this kiln, from which it derives its title, is that once the firing has been started it is left to take its course, no provision being made for taking *tests*. This is, I think, a defect, but it is minimised by the possibility of adapting the fuel to the work to be done.

The *fuel* is either wood, or charcoal, or cinders, according to the degree of heat required. This degree must be ascertained by experiment. As the muffle must be raised to a low red previously to placing anything in it for firing, so to expel every trace of moisture which brick will take up, the opportunity may be taken of placing a test in it for the purpose of determining which kind of fuel and how much of it should be used. Cinders or wood is stated to be sufficient for glass and crystal, small charcoal being required for porcelain or earthenware. Any intermediate heat can, of course, be obtained by an appropriate mixture of fuel. The fuel is laid in the ordinary way; the muffle, packed with the articles to be fired, is placed on the supports, so that the projections on the ends of the latter retain the door in position; the flue of the muffle is placed in position; the spaces between the muffle and the sides and top of the kiln are filled up with fuel; the top and smoke flue are adjusted; and it only remains to light up. "The firing now goes on without any more attention, or even the presence of any one; the heat spreads, the muffle and its contents become red hot; the colours adhere and become fixed, the fuel consumes itself, and the fire goes out." The kiln may be stood in an open grate, with the smoke flue up the chimney, but if this cannot be done, the firing should be conducted in the open air

243. *Packing the Muffle.*—Great care should be exercised in arranging the articles in the muffle so that they shall not touch each other, but shall remain firm. The supports should be of fire-brick with a pointed end, on which ends the ware rests. A most important point in packing is that *the pieces must not be too close together*. If they are, they, to use the technical term, *sweat*. Even professional firing is not always free from this, the inducement being great to put as much as possible in for one firing. I have been advised by one of the most skilled and experienced of firers that not less than 1½ inches should be between the pieces. The instructions say that it is not necessary to lute the lid when putting the muffle into the lid, but looking to the disastrous results of allowing acid gases to touch the paint, I counsel a slight luting with clay.

244. *Cooling.*—The whole apparatus must be allowed to cool thoroughly before any part is removed for if cold air were allowed to get at the baked ware at a high heat it would crack. When the kiln is cool enough to handle, the lid may be taken off, the muffle taken out, its lid and the pieces then removed.

245. *Renewal.*—"Any part," chimney, door, plates, etc., "can be obtained separately, and on an emergency sheet iron can be used, to replace a broken plate of fire-brick." It is also suggested that "a cracked muffle, or even a broken one, can still render good service by filling up the cracks, or joining up the pieces with clay, and holding the whole up by means of iron wire or bands."

It is proper that I should state that I have not personally used this kiln, as, living in London, it is so convenient for me to have my firing done at a regular place; but I have examined it, and do not doubt that it would do what is claimed for it.

246. *Firers.*—It may be useful for painters living near London, who cannot fire their own ware, if I state that I have had excellent results from Lechertier, Barbe, and Co., and Kennedy and Brown, both already mentioned; and especially Battam and Co., *Johnson's Court*, *Fleet Street*, who will carry out specific instructions. The last-named have the very special qualification of being able to mend broken pieces by cementing with glaze and firing, sometimes a most valuable remedy for overzeal, or, shall I say, recklessness. I believe that Hancock and Sons also undertake firing.

(*To be concluded in the next.*)

MODEL ENGINE-MAKING.

By J. POCOCK.

II.—SINGLE ACTION OSCILLATING CYLINDER ENGINE.

A DESCRIPTION of the fitting up of a model single action oscillating cylinder engine is placed first in the series of models I hope to describe in the course of these articles, because, owing to simplicity and to the fact that it is not necessary to bore the cylinder, few tools are required, and the beginner is more likely to succeed in its construction; while at the same time the cost of the requisite materials is so trifling that it is not a matter of great importance should any part be spoilt and have to be replaced.

Thus, although the single action model has no useful prototype, it is itself useful as a stepping-stone to the modelling and comprehension of more complicated engines, especially those belonging to the oscillating class; and it may not be without interest to note that the great Watt himself constructed at

least one model of an oscillating engine, a drawing of which we give in Fig. 24.

The castings, etc., required for the model in question are shown in Figs. 14 to 23. Such a set of castings, together with a piece of brass from which to form the bed-plate, will be supplied by Mr. R. A. Lee for 2s. The castings consist of the fly-wheel, a pair of standards, the crank, steam block cylinder, bottom and top, and piston, and a small piece of brass tubing is supplied with the castings for the body of the cylinder.

The cylinder being the most important part, we will attack it first.

Such a cylinder as the one under consideration—wood with a little fine emery and oil, and holding the bit of tube between the fingers, set the lathe in motion and grind the tube out smooth. Before taking the tubing out of the lathe, it may be forced up to the end of the wood which has not been used in the grinding process. This part will now be just large enough to hold it securely while the ends are turned off true, and the outside polished with a piece of fine emery paper.

If the lathe be a good one, and its owner should not care to use it for grinding purposes, this part of the process may easily be carried out by hand.

The next part to be taken in hand is the bottom

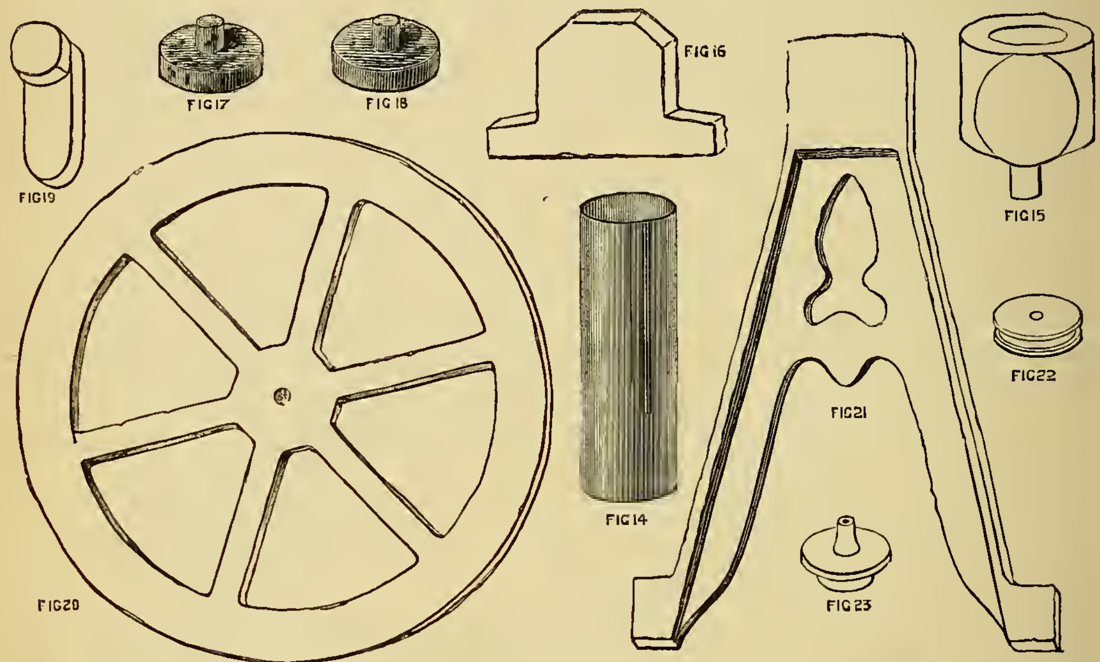


FIG. 14.—PIECE OF TUBE FOR CYLINDER. FIG. 15.—BOTTOM OF CYLINDER. FIG. 16.—STEAM BLOCK. FIGS. 17 AND 22.—PISTON. FIGS. 18 AND 23.—TOP OF CYLINDER. FIG. 19.—CRANK. FIG. 20.—FLYWHEEL. FIG. 21.—STANDARD.

viz., ½ inch bore, and 1½ inch stroke single action, will not require boring, but the interior must be smoothed out. In order to accomplish this, turn down a piece of soft wood to a slightly taper form at one end, in such a manner that the smallest part of the tapering end will pass easily through the small piece of tube which is to form the cylinder. From this end the piece of wood should increase in size till it is just so large that it would require hammering to drive it through the cylinder, and from this point to the other end the wood should be turned level and cylindrical.

This piece of wood being turned, it is to be mounted between the lathe centres, with the piece of cylinder tubing upon one end of it. Now coat the

of the cylinder, shown in Fig. 15. This piece must be held in a grip-chuck by the tenon shown at the lower part of the figure, and the interior of the piece is to be turned out until the cylinder tube will just slide stiffly into it, the bottom being turned out square, and the top edge neatly turned off either square or to a bevel from the outside according to fancy. Now take the cylinder bottom out of the chuck, and placing it in the vice, file off the tenon, leaving the bottom square and smooth. File up the outside all round, leaving it as smooth and truly round as possible, and file also the bearing-face, shown to the front in the figure, till it is smooth and as level and square as possible to the top, and consequently parallel with the inside. The centre of this

face should now be found, and a circle struck from it as near the edge as can be managed; and then, using this circle as a guide, the edge must be filed up circular; or if the piece can be conveniently chucked for the purpose, it may be again mounted in the lathe, properly centred (taking care that the bearing-face is exactly at right angles to the mandrel), and the face and edge turned up. If this is properly done, this important part will require no further finishing.

The piston, Fig. 17, is now to be turned up. The turning of the lower face and edge can be done while the piece is held in the grip-chuck by its tenon, a flat groove being turned in the edge to take the packing, as seen in Fig. 22, and while still in the lathe it should be drilled for tapping with the screw for piston-rod. The piston is now to be reversed, and the tenon cut off, and the upper side turned. The centre hole may now be tapped, and the piece placed on one side for the present.

The top for the cylinder, Fig. 18, is to be turned up in the same manner as the piston, but the edge, instead of being grooved, will be turned down on the lower side, leaving a flange on the upper side, and the edge where turned down smaller should be left very slightly conical, and of such a diameter that it will be a stiff fit in the cylinder tube. The top must be drilled through while in the lathe. The tenon, instead of being cut off, may be turned up, as shown in Fig. 23. This will give the cylinder a more finished appearance.

The steam-block, Fig. 16, and the crank, Fig. 19, have only at present to be filed up, and left as neat in shape, and as smooth as possible.

The fly-wheel, Fig. 20, must next be centred, drilled, and mounted on a temporary shaft for turning. This will be found better in most cases than turning it on its own shaft, there being in the latter mode considerable risk of breaking the shaft unless this latter is made so stout as to look clumsy in the finished model. The fly-wheel need only be turned upon its edge; the sides made smooth with a file.

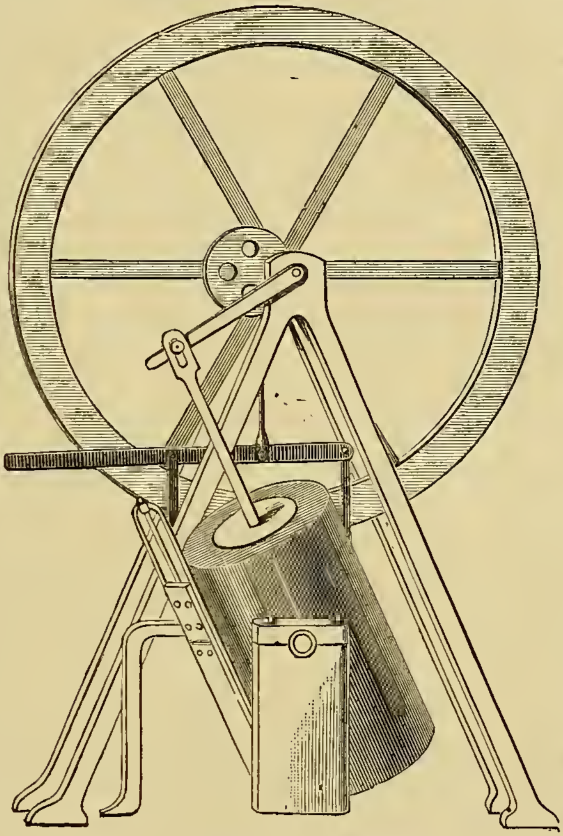


FIG. 24.—MODEL OF ENGINE, WITH OSCILLATING CYLINDER, CONSTRUCTED BY WATT.

The standards, Fig. 21, and the bed-plate, may now be filed up, the openings in the standards being worked with round and half-round files. The bed-plate must be squared up with the aid of the steel square.

Some screws and nuts will be required in the fitting together of the several parts, and these, if not purchased, should now be made. The nuts may be made of any piece of stout brass about one-tenth of an inch thick, as an old clock plate for instance. From some such piece cut off with a cold chisel or otherwise a strip $2\frac{1}{2}$ inches long by $\frac{5}{8}$ inch wide; mark this strip off into square pieces, and file about half way through at each mark. Now centre-punch each square, and drill through with a drill suited to the tap which is to be used, which latter should be about one-tenth of an inch in diameter. Now tap each hole, when you will find yourself supplied with a row of nuts which only require to be broken off from the strip and filed up at the edges. If preferred, the corners may be filed off, and the nuts thus made octagonal. For the screws, take a piece of brass wire, about No. 6 New Standard Gauge, and file $\frac{1}{2}$ inch at one end down till it is the right size to take the same gauge of screw-thread as that used for the nuts. Cut the thread with the screw-plate, and cut off the screw with a head about one-eighth of an inch deep. File the head up flat in the vice, and notch with a knife-file; or if preferred, rather larger wire may be used in the first instance, and the heads filed up either square or octagonal, in which case they will not have to be notched. Of course, if a proper chuck is available, it will be quicker to turn the wire for the screws down in the lathe.

Now with the square mark on the bed-plate two lines exactly parallel, the first about quarter of an inch from the edge of the bed-plate, the second about

one inch from the first. Now drill through the two feet of each standard with a drill a trifle larger than the screws you are using, so that the holes when drilled will allow the screws to pass through them ; place one of the standards on the bed-plate with the outside of its feet against the first line, and mark the bed-plate through the drilled holes. The second standard should now be placed with its feet just the further side of the second line, and again mark. This should leave about three-quarters of an inch clear space between the standards. It is as well to mark the standards and bed-plate so that the standards may in fitting up be again placed without difficulty in the same position in which they were marked.

To mark the bed-plate, it is a good plan to make a small centre-punch of a piece of steel wire the same size as the screws used, and about half an inch in length. This should be filed at the end to rather an obtuse, but at the same time, sharp point, and hardened ; it is then to be placed in the hole in the standard or other piece whose position on the bed-plate we desire to mark. It will stand upright, and a sharp blow upon it with a light hammer will centre-punch the bed-plate ready for drilling.

The four holes for the standards may now be drilled in the bed-plate. These must be the same size as those already drilled in the standards, and the standards may now be bolted to the bed-plate and tested with a square. They will probably be found to stand considerably out of the perpendicular, in which case they must be taken off the bed-plate, and the feet must be filed and fitted so that the standards, when bolted to the bed-plate, stand quite perpendicular to it, and parallel with each other.

A centre mark is now to be made on each side in the centre of the solid top piece of each standard, and the standards being bolted to the bed-plate, and a piece of wood placed between them to prevent their giving under the pressure. The hole for the fly-wheel shaft may be bored in the lathe, through both standards at one operation ; this hole may be $\frac{1}{8}$ inch to $\frac{1}{10}$ inch in diameter.

The standards may, however, if preferred, be bored for the fly-wheel shaft before their position is marked upon the bed-plate ; in this case the shaft also should be turned and finished before the position of the standards is determined, and the shaft must be placed in position when marking the position of the standards, so as to insure the coincidence of the two bearings. The holes in the bed-plate may also take the form of short slots, so as to allow a slight adjustment to be made in the position of the standards.

The fitting of the engine will be described in the next article.

(*To be continued.*)

NOTES ON NOVELTIES.

By THE EDITOR.

24. The Waterbury Watch. 25. Goy, Limited. 26. Perry and Company, Limited. 27. Leek and Son's Walking, Cycling, and Cricketing Shoes. 28. Melhuish and Sons' Catalogue and Price List.

24. THE WATERBURY WATCH.—Those who read the advertising pages of this Magazine will have noticed that the Publishers are willing to supply anyone who may wish to take advantage of their offer with a watch post free, and a copy of the Magazine, as published, for twelve months, for 14s. In point of fact, bearing in mind that the sale price of the Magazine for twelve months is 6s., the Publishers give any subscriber for this period the chance of getting a good watch, post free, for 8s. And the transmission of the watch in the first instance, and the regular supply of the Magazine are so secured by the Publishers, that it is next to impossible that any failure can be made in completing the bargain. Now it is very possible that some of my readers would like to know my opinion of the watch, and, as I have had one handed to me for the express purpose of trying it and reporting thereon, I am in a position to give it. Well, the watch I may say is a strong, good-looking article, so well finished that whenever it is looked at, consulted, or examined, it invariably provokes wonder as to how it can be made for the money. Buyers of the "Waterbury" can get a good watch for a nominal sum, and one that will do them excellent service. In addition to this, the repairs are never burdensome, for if a watch get broken by any mischance, or out of order, it will be put to rights by the Waterbury Watch Company, 16, *Holborn Viaduct*, *London*, *E.C.*, on receipt of 2s. 6d., with the watch, and if the repairs do not cost so much, the Company will return the balance with the repaired timekeeper.

Every watch is sent out in a stout box lined with satin, and is accompanied by a little book of instructions for winding and starting the watch, which, although it bears a strong resemblance to watches of an ordinary kind, yet differs from them in many particulars. Firstly, it is a "keyless" watch, or "stem-winder," as the Company prefer to call it ; and, secondly, the glass and bezel in which it is set is entirely removable from the body of the watch, and not attached to it by a hinge. Now it is the removal and replacement of the glass and bezel, and the winding of the watch, that chiefly bothers—if I may be permitted to use so unparliamentary an expression—anyone who uses one of these watches for the first time, especially if he has been accustomed to carry an ordinary watch. When I first removed the bezel, I am ashamed to say it took me about twenty minutes before I managed to snap it on again, and my patience was sorely tried, but on pressing it on there is a knack as well as in many other things, and it appears to me to consist in putting the thumbs over the frame of the glass in such a manner as to render the pressure all round the circle as equal as possible at every point. Again, being accustomed to wind up my watch but once a day, and then

to make six or seven turns of the key only, I did not bear in mind the injunction of the Company: "to give the crown a few turns whenever you have occasion to look at it during the day," and thus, unconsciously, your watch is always wound up. In a few days, however, I managed to overcome these difficulties, and now it is all plain sailing. If the watch runs down, it takes full two minutes to wind it up: the first time it ran down, I thought I should never have got to the end of the winding. Above all things, it is beyond all others the watch for a boy. It is a cheap gift to the person who makes the present, but the recipient will value it none the less for that. He will be the owner of a watch, and rejoice accordingly. Further, he will never forget to keep it wound up to the utmost for the first few days of possession, for he will delight in turning the crown whenever he takes it out of his pocket, and that will be often enough, one may be sure. And when the novelty of being the owner of a real good watch begins to wear off, the winding will have become a matter of habit, and he will keep it up accordingly. Lastly, if the watch comes to grief, the cost of the repair is low, and unlikely to prove burdensome, either to the boy or any relative who may be good-tempered enough to pay for the damage. No purchaser of AMATEUR WORK, I think, will ever regret buying a Waterbury Watch in conjunction with the Magazine, whether for his own or another's use, at the low price at which they are offered together by the Publishers.

25. *Goy, Limited.*—Our old friend "Goy," the initiator of the system of sale of expensive articles for twelve equal payments, extending over a year, has developed himself into "Goy, Limited," a Company with a capital of £25,000 in 25,000 shares of £1 each. The office is at 21, *Leadenhall Street, E.C.*, and Mr. F. Peach, heretofore the genial and obliging Manager of the business under the enterprising chief, is now the Company's Secretary. I have already dwelt on the advantages to be derived by dealing with "Goy," namely, the immediate acquirement of any article, be it what it may—bicycle, tricycle, lathe, sewing-machine, canoe, or what you will—by twelve equal payments made at intervals of a month, from the first payment at date of purchase. Unfortunately, the share list will have closed before this can meet the eyes of my readers, but shares are articles which are matters of sale and purchase, and, without doubt, it will be possible to pick up a few now and then—at a premium. I do not think anyone will do wrong in becoming a shareholder. At all events, buyers always know the extent of their liability. *The profits for the last fourteen years have averaged* 18 *per cent. on the capital* employed. With the increased facilities for doing business, brought about by additional capital, they will, in all probability, be greater.

26. *Perry and Company, Limited.*—Apropos to what I have been saying, and very opportunely, the Report and Accounts of Perry and Company, Limited, of 36, *Lancaster Street, Birmingham*, and *Holborn Viaduct, London, E.C.*, has just reached me. From this, it appears that the nett profits of the year 1885, including the balance carried forward from Profit and Loss Account, 1884, amount to £24,271 0s. 1d., which enables the Directors to declare a dividend of 10 per cent. for the year, the same as that paid for 1883 and 1884. Now, considering the times and general depression in trade, this is a very handsome rate of interest, and will no doubt prove an inducement to small capitalists to make inquiry after any shares that may be in the market.

27. *Leek and Son's Walking, Cycling and Cricketing Shoes.*—I am aware that a large contingent of readers of AMATEUR WORK are "wheelmen," and possibly a still greater number are compelled to resort to that means of locomotion that is popularly and widely known as "Shanks's Mare," and I am glad, in the interest of these large sections of "ours," to be enabled to call attention to the Registered "Walking, Cycling, and Cricketing Shoes," introduced and manufactured by Messrs. Leek and Son, 11, *Ironmarket, Newcastle, Staffordshire*, who are wheelmen themselves, and have been led by their experience, in cycling and walking, to hit on a peculiar make of shoe which is at once durable, extremely well made, handsome in appearance, and comfortable to wear. The value of Messrs. Leek and Son's shoes for walking lies in the fact of their extreme flexibility, which renders them at all times easy; the leather, moreover, is beautifully soft, and the best of its kind, to judge from the specimen pair which I have carefully examined, and the workmanship is unexceptionable. In general appearance the shoes are much like other shoes, and it is only when the soles are examined that the difference is perceptible. The surface of the sole is formed chiefly of india-rubber, which is grooved thus: VVV, in ridge and furrow form. The tip is formed of leather, and so is the part next the waist, and between these parts comes the india-rubber. The waist is that which is known as the "Flexura" waist, and the heels are broad and strong, and not too high—a great fault in most modern boots and shoes. The introduction of the grooved india-rubber is attended with these advantages: It allows a free current of air to pass underneath the foot, and prevents the penetration of damp; and when walking, climbing mountains, etc., its peculiar formation tends effectually to prevent slipping. They are specially useful to cyclists, in that they do not slip off the pedals as a smooth surface would, and they lead the crank further round, and give additional power in getting up hill. To render them well adapted for cricketing, all that is necessary to do is to put a spike in the heel of the shoe, which can be removed at pleasure. By this simple addition, the shoes can be rendered as serviceable for cricketing as the most ardent cricketer could wish. The price per pair is 16s. 6d. In ordering from the makers send an old shoe as a guide to size.

28. *Melhuish and Sons' Catalogue and Price List.*—On and after April 1—it is not a happy date on which to fix for the commencement of a new departure, but *absit omen!*—Messrs. Richard Melhuish and Sons, Builders' Ironmongers, etc., 85 *and* 87, *Fetter Lane, Holborn Circus, E.C.*, will send out their ample and admirable catalogue of tools, machinery, and fittings of all kinds, nicely bound in cloth, gilt, post free for 9d., in stamps. The catalogue to which reference is made is a large crown 8vo volume of 272 pages, containing many hundred engravings, and thoroughly well fitted, both from the nature of its contents and its appearance, to take its place among the reference volumes on the bookshelves of any amateur. I need scarcely point out that the

appearance of this handy catalogue in cloth binding, instead of paper covers, adds greatly to its utility, inasmuch as those who possess it in this form will be spared the annoyance of the damage, which invariably falls to the lot of any book in a paper wrapper that is frequently used for reference. Of course, 9d. is no great sum to pay for a book of this kind, especially when it is remembered that a considerable portion of this amount must be absorbed in payment for transmission by parcels post, but Messrs. Melhuish and Sons consider that it will be to the mutual advantage of themselves and their customers that have been, that are, and that are yet to come, that their price list should be attainable in this form, and they have therefore resolved to adopt the more expensive form of binding, even though it may entail some pecuniary sacrifice on their part. I may say that I never look through this price list myself without deriving profit in the information that I gather from it, for I am often in want of some particular tool, appliance, or fitting, and if I do not get the very thing itself at all times, I generally get a clue to some substitute that will answer my purpose as well, or to the method of making some contrivance which will exactly meet my need. And I always find Messrs. Melhuish and Sons very ready and willing to satisfy my—crotchets, perhaps, in making what I require, if there is nothing in stock that suits my requirements.

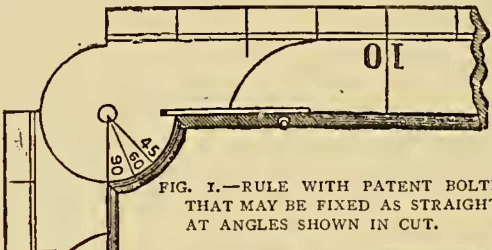


FIG. 1.—RULE WITH PATENT BOLTED JOINT THAT MAY BE FIXED AS STRAIGHTEDGE OR AT ANGLES SHOWN IN CUT.

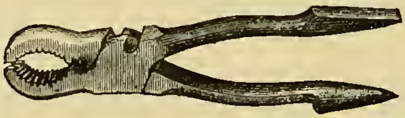


FIG. 2.—COMBINATION GAS PLIERS, PIPE OPENER, SCREW-DRIVER, ETC.

FIG. 3.—ROUND-NOSE COMBINATION PLIERS, WITH WIRE CUTTER, ETC.

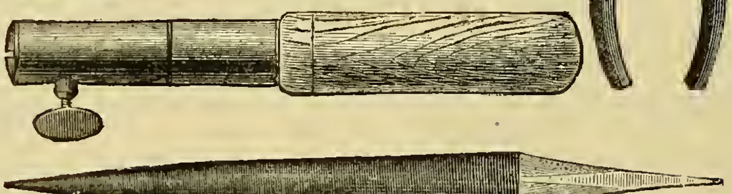


FIG. 4.—HARDWOOD HANDLE AND SOCKET FOR HOLDING WARDING FILES, ETC.

In the illustrations that accompany these remarks will be found representations of tools and appliances that every amateur requires who works in wood and metal. No carpenter can do without a rule, but there are rules *and* rules, and having stepped on a good old servant of mine, and placed it *hors de combat* by the fracture that unhappily followed, I have provided myself with another fitted with the patent bolted joint that I can recommend. The rule, fitted with this bolt, possesses advantages over the ordinary rule, in that it can be bolted straight open to form a straightedge for ruling, throughout its length, or at an angle of 90°, to form a square, or at angles of 60° or 45°, as may be desired, to form bevels, etc., at these angles. The joint is shown in Fig. 1. It is made in two forms, known as the "Wellington" Joint and the "Arch" Joint, the latter form being shown in the engraving. The two kinds of combination pliers, shown in Figs. 2 and 3, will be found useful, both of them being furnished with nippers for cutting wire, and the Hardwood Handle and Socket for holding warding and other files, will, I venture to say, be heartily welcomed by those who have occasion to do a little in key-cutting or in filing metal work, in which it is necessary to use a small file. It dispenses with the necessity of keeping a large variety of files in handles, as one handle will serve for many. This is a palpable advantage when and where it is an object to economise space.

There are many things in Messrs. Melhuish and Sons' price list to which I might call attention with advantage, but space hinders me from touching on more than two or three of them. Time and space seriously interfere with the good intentions of all of us, if I may venture to use my own experience as a measure for the rest of mankind. Among these two or three special things are the chests of drawers and boxes for tools and ironmongery, in thirteen different sizes, and at prices ranging from 3s. 3d. to 25s. 6d. An amateur, I know, ought to make such things for himself, but here, you see, the question of time steps in. In blind furniture Messrs. Melhuish and Sons have many good things, and among them stands conspicuous the patent self-fastening action for blinds, suitable for either one or two cords, and therefore especially suitable for Venetian Blinds with two cords, because it not only retains the blind automatically at any desired point, without requiring spring cord or extra check string, but tends to obviate liability to fracture in the cords themselves, and affords effectual security against the accidents which frequently arise from cords of heavy blinds being released before they are properly secured. I must refer my readers to the Catalogue itself for description and illustration of cutlery, door furniture, filters, cases of mathematical instruments, and many other things which are included in Messrs. Melhuish and Sons' large and varied stock.

I have many other useful things before me, to which I am anxious to call the attention of my readers, but I must leave the mention of these for another month.

AMATEURS IN COUNCIL.

*** *For Instructions to Correspondents, see page 44 of this Volume.*

Cycling as an Exercise.

NEPENTHE writes:—"M. H. W. (*Manchester*), asks the question I entertained seriously for several months, before purchasing a tricycle for use of my wife and myself. We could walk fairly well, but with subsequent fatigue and discomfort if the exercise were protracted to the fifth mile. Our occupations being sedentary it becams, as our radius for pleasurable walking was so limited, quite necessary to vary it both in quantity and quality of interest, and I purchased, last May, a 'Genuine Humber Tandem,' which we have used every day since, when weather and roads permitted. I can, therefore, testify, First, that our general health and strength have vastly improved; Second, that our walking powers have greatly increased; Third, that our new exercise has wonderfully widened our area, with corresponding growth of interests within it; and, Fourth, that in itself the machine and its gifts to us are equally fascinating. I commend the same practice to M. H. W."

CYCLIST writes: — "Judging from the reply to M. H. W., Vol. V., page 188, *re* above, our Editor is *not* a cyclist, or he would not prefer walking to cycling. That walking is the exercise most easily and readily obtained is self-evident, but I think no cyclist ever walks (as an exercise) when he can use his machine. In that walking exercise can be taken in all weathers, it is doubtless superior, but when the roads are fairly dry a cyclist can get over a much greater extent of ground, and so get more variety and change of scene and air, with the same amount of exertion. In my case I purchased a 'Sociable' last April for myself and wife. We are both of us poor walkers, three to four miles being quite enough for us at one spell. After a few weeks' practice on the tricycle, we got through our twenty miles in about four hours, including stoppages to take four photographs on the road. This, of course, would be a mere nothing to a great many riders. We did not try to make a record, but to enjoy ourselves and to get some fresh air. Regarding the effect on health, I cannot do better than refer M. H. W. to a work written by Dr. Richardson, published by Isbister, of *London*—'The Tricycle in Relation to Health and Recreation,' which enters very fully into the whole question. Dr. R. sums up in these words: 'It causes the chest to fill and empty without undue labour, it leads to a good oxygenation of the blood. . . It relieves depression of mind, it promotes a healthy desire for wholesome food, and it invites naturally a good wholesome and refreshing sleep.' I can fully bear out this statement, and could add a deal more to the same purpose, though I fear I have taken up too much space already. My excuse is, that the cycle will, I believe, have a very important bearing on the future health of the community, enabling the inhabitant of town to get into the purer air of the country by his own exertions, employing both his mind and body at the same time, and, if properly used, straining neither." [As CYCLIST shrewdly surmises, I am *not* a cyclist, but that is my misfortune and not my fault. I cannot "make time" for doing half the things I would like to do, and I am obliged, like thousands of others, to subordinate even my exercise to my life-work and duties. I could very seldom use a cycle of any kind, even if I possessed one. By no means do I undervalue cycling as an exercise; on the contrary I am sometimes disposed to wish I could do as I see others doing in this way, when I meet them or when they pass me on the road or in the street.—ED.]

Renovating Files.

A. E. S. (*Horsham*).—Saleratus is the name given to a mixture of carbonate of soda and salt, and is used, with cream of tartar, for making bread. If used at all in "recutting," or rather renovating, files, it would only be used for cleansing purposes, for which hot water and ordinary soda is sufficient. To renovate files, first thoroughly cleanse the file from all particles of metal, dirt, etc., adhering to it. Then plunge it into a solution of one part nitric acid, three parts sulphuric acid, and six parts of water, for a period varying from a quarter of a minute to five minutes, the time depending on the fineness or coarseness of the file, and the extent to which it has been worn, the coarser the file and the more worn the longer the time. Then wash in water, dip in milk of lime, wash off the lime, dry in gentle heat, and then brush over with a mixture of olive oil and turpentine in equal parts.

Drill and Lathe Chuck.

E. C. R. (*Southwark*).—You will find illustrations of drill and lathe chucks in the large and comprehensive catalogue issued by Messrs. Charles Churchill and Co., 21, *Cross Street, Finsbury, E.C.*, which will be sufficient to guide you in making working drawings for your own use. It will require considerable skill in metal working to enable any amateur to make such a thing as a "three or four jaw drill and lathe chuck," and I think it would be better for you to purchase one. They are expensive articles, but if you do not feel inclined to buy one outright at one payment, Goy, 21 and 22, *Leadenhall Street, E.C.*, will supply you with one on his hire system, by which you can acquire any piece of machinery you want by twelve equal monthly payments. Call on him and show him this reply to your query.

Silicine Glass Painting.

ROSELBA.—The Silicine Process of Painting on Glass is an excellent one, and in every way worthy the attention of amateurs. You ask, "Have any of ours tried it?" Yes; and A. C. J. (*Whittlesford*) speaks in high commendation of it, as you may see if you will refer to Vol. IV., page 403. For the benefit of other readers I may repeat that the materials for carrying out the process may be obtained from any artists' colourman, or from Messrs. G. C. Beissbarth Son, 39, *Farringdon Road, London, E.C.* The pamphlet describing the process may be written in "dreadful English," and the passage you quote is certainly somewhat involved, but this ought not to prejudice you against the process, which I can strongly recommend. "The proof of the pudding," you know, "is in the eating;" and I venture to suggest that you should make trial of the process, notwithstanding the lame English in which its inventor describes it. His shortcomings in this respect in no way detract from the utility of his invention.

Clock Work for Electric Clocks.

J. H. (*Romford*).—I can only refer you to the reply given to C. C. F., in page 192 of this Volume, and to Professor Marisiaux's reply to LEX in page 191, col. 3. Works are not specially supplied for the purpose of making electric clocks, but you can pick up an old clock at the clockmaker's or marine store dealer's, and adapt the works to your purpose.

Prices of Lathes.

SPAX.—You ask, "What is the lowest price at which a serviceable lathe for light work can be bought?" It depends very much on whether you buy a secondhand lathe or a new one. You might get a secondhand machine that would suit your purpose for half the sum you would have to give for a new one. A good plain treadle lathe costs from £6 to £7, and if I were buying for my own use I should not care for a cheaper one. The best advice I can give you is to send for the price-lists of the Britannia Company, *Colchester*; Messrs. Charles Churchill and Co., 21, *Cross Street, Finsbury, E.C.*; R. A. Lee, Engineer, 76a, *High Holborn, W.C.*; Messrs. Richard Melhuish and Sons, 85 and 87, *Fetter Lane, Holborn Circus, W.C.*; and other makers and dealers, and then make choice of such a machine as will best suit your means, and the work you want to do.

Wheels for Electric Clock.

R. T. RUST (43, *Norcott Road, Stoke Newington*) writes:—"I am having a dozen sets of wheels cut for the electric clock and, having a few to spare, shall be pleased to supply any of your readers with same, price 5s. 3d., post free." [Persons desirous of having sets of wheels must communicate direct with Mr. RUST, whose address I give for this purpose.—ED.]

Clock Movements for Moving Models.

W. J. W.—Clock movements suitable for moving models can be obtained of Messrs. Mayer and Son, 27, *Aldersgate Street, E.C.*, at prices ranging from 3s. 6d. to 5s. 6d.

Bookbinding.

GOLDSMITH.—You cannot expect to bind a book without having some trouble. The wire staple must be taken out, and if you want to bind your book you must sew each sheet. What is it after all? Only thirty-six sheets. You ought to be able to get away the glue without tearing or splitting a single sheet. The advertisements come away easily, in fact, the whole comes away so clean, that when bound, one can hardly tell if the book has been wrapped or not. Try again, and if you cannot get on properly, let me know next month, and I will show you how to do it. — AUTHOR OF "Bookbinding for Amateurs."

Bookbinder's Materials, etc.

A. V. P. (*Islington*).—You can get all you want from Eadie and Sous, 53, *Great Queen Street, Lincoln's Inn Fields, W.C.*, or Corfield, 21, *St. Bride Street, Ludgate Circus, E.C.*; but if you want presses and tools as well try Hill, 6, *Charles Street, Hatton Garden, E.C.*—Author of "Bookbinding for Amateurs."

Turbine Water Motor.

J. H. (*Whitchurch*).—You ask: What quantity of water and what fall you would want to drive a small lathe for two or three hours? I should be happy to help you, but you say in your letter that you have no supply, and that you would have to raise the water, how do you intend to do this?—if by hand, would not the same energy (wasted in raising water) be better employed in working your lathe. A fall of 30 feet and a one-inch pipe, with a tank 8 feet by 4 by 4 would do nicely for your purpose.—F. J. Durrance.

A. T. E. J.—You ask, Will the Turbine Water Motor described in Amateur Work for February, 1886, be strong enough to work a small dynamo to light six lamps of 10-candle power each. You would have to make the turbine *double* the size to do this satisfactory, then you would have ample power with a pressure of about 40 pounds.—F. J. Durrance.

Strength of Springs.

Spax.—If equal amounts of energy were imparted to each spring, then each would restore equal amounts. But the contracting spring would buckle and double up when strained in expansion, and if it did not there would still be a loss in the tendency to do so. The spring which expands in doing its work is by far the strongest. Take the hair spring of a watch. You may coil it up closely without injury, but attempt to uncoil it and a wreck will ensue. Yet these springs work under both conditions. But to enter into this subject would be mere waste of time and space. Life is too short for hair-splitting on such subjects. Suppose a spring coiled up and secured, then immersed in acid until it is dissolved, what becomes of the energy imparted to it? Or a frog jumps into the air and is swallowed by a duck, what becomes of the energy which existed in the jump? I don't want answers to those questions, but only quote them under the circumstances, to show that yours is not unlike in importance.—Olla Podrida.

Splicing Wire Ropes.

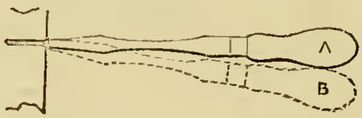
A. W. W. (*Gateshead*).—Wire ropes *are* spliced in the same manner as hemp ropes. I have never spliced any myself, but have seen it done scores of times. I am well acquainted with the splicing of hemp ropes, and therefore ought to be able to draw a comparison between the practices. The methods of wire rope splicing cannot differ much in different places. Where I am there are many experts, and steel wire ropes are frequently spliced to carry 20 or 30 tons. I saw one this week, spliced for a sling to carry a working load of 42 tons. I asked the expert who did it whether there was any difference between the splicing of that and a hemp rope. His reply was, "Exactly the same, only there being a larger number of strands in a wire rope, more care must be exercised in laying the parts, and in 'fining' off the ends." I only repeat "in substance" what I said before in a reply to you upon the same subject. You "know it to be incorrect," so I add a little evidence in support of my previous statement. Perhaps somebody else will come to the front with their experience.—Olla Podrida.

Designs and Models for Wood Carving.

R. D. (*Nottingham*) writes:—"Having noticed several times enquiries in Amateur Work for the above, I beg to inform my fellow-amateurs that I have used those supplied by Mr. G. A. Rogers, 29, *Maddox Street, London, W.*, for many years, and have found them excellent to work from. For full-sized wood carving designs, pure and simple (not fretwork), they are the best I have met with."

Screw Driver.

Spax.—The long screw driver gains its power through the angle at which it may be held and worked. If it were carried in a bearing so that it couldn't "wobble" around, then its effective leverage would be no greater than a short one having the *same size handle*. Reference to the diagram will give a clearer idea of this. If the



ACTION OF LONG SCREWDRIVER.

screw driver was held as shown at A, the power would only be equal to that of a short one with a handle similar in size. But the length of the tool permits of its being angled, as shown at B in dotted lines, without slipping out of the slot, and this angle gives increased leverage and with it as a matter of course, greater power. As the tool increases in length so also may the dotted angle.—Olla Podrida.

Magic Lantern.

H. B. writes:—"As this instrument is now very popular, and possesses elements of great interest, and peculiarly adapted for home construction by an amateur, I ask, as an old subscriber to your very instructive and valuable Magazine, if you could induce one of your able contributors, well versed in this particular instrument, to write a series of articles upon its construction, giving full details, something after the style adopted in a previous Volume by Mr. Richard Thomson in his able papers on the Microscope. In asking for a Magic Lantern, I do not mean a toy, but a set of lanterns with mahogany bodies, having every possible appliance—dissolving, microscopical, mechanical, and other combinations. I, for one—and I am certain there are others of your subscribers—would very gladly undertake the construction of this instrument if only a set of such lanterns as I propose were fully described, and full details of construction given in the Magazine." [Will some of "ours" express their views on this subject?—Ed.]

Terrestrial and Water Telescopes.

J. L. D. (*New Quay*).—Telescopes differ in size, so it is not possible to lay down "the exact shape and size" of a telescope for this reason. The shape is the same in all—that is to say, they are cylindrical in form—but it will depend on circumstances whether a telescope consists of one cylinder only, or of more. I must refer you to the description of "A Cheap Astronomical Telescope," given in Vol. III., page 303 (in Part 32) of this Magazine, and the admirable series of papers on "The Reflecting Telescope," now appearing in the current Volume. For the description of a water telescope, see Vol. III., page 86 (or Part 25), from which you will see that it is nothing more than a tube, which you may make of wood or metal, as you please, with a piece of clear glass at one end. It may be cylindrical or square in form, according to fancy.

Cane Bottom and Rush Chairs.

F. P. (*Andover*) wishes to know price and address where to obtain cane bottom and rush chairs, or for instructions for making them. The chairs you mention may be obtained of any upholsterer, at prices ranging from 3s. 6d. upwards. A careful examination of a cane-bottom chair and a rush chair will show you very clearly how the chairs are made—as far as the frames and seats are concerned. To become acquainted with the *modus operandi* involved in making the frames of cane-bottomed chairs, visit the workshop of any chair-maker in High Wycombe, or any of the neighbouring villages. I cannot possibly find space for detailed instructions for making chairs of this description, though I would insert an article on executing or repairing canework. No amateur would find it worth his while to attempt more than this.

Oval and Round Frames.

F. P. (*Andover*).—You can obtain oval and round frames of Mr. Gus. Rochefort, *Basinghall Street, E.C.*; Mr. George Rees, 41, 42, *and* 43, *Russell Street, Covent Garden, London, E.C.*; or any other picture-frame maker, and from these makers you may learn the price of any frame, whether oval, round, or square, if you will send the dimensions of the frame or frames required. To make an oval or round frame, you must first make your frame in flat wood—cutting it out of the solid if it be a small one—and then work your moulding with a cutter or scraper, to give it the requisite form, and cut out your rebate, for glass, picture, etc. You would find the Windsor Hand Beader, described in page 230, a useful tool for this kind of work.

Type for Recasting.

F. P. (*Andover*).—Type metal is composed of lead and antimony, used in various proportions: from 9 parts of lead to 1 of antimony for large common type, to 3 parts of lead to 1 of antimony for the smallest kinds of type. The alloy is formed by melting the ingredients together, and thus incorporating them. I do not suppose you would be able to buy type metal of the typefounders, who make it for their own use, and not for sale. Old type for recasting is sent to the typefounders, such as Messrs. Harrild and Co., *Fleet Works, Farringdon*

Street, E.C.; and Messrs. Figgins and Co., *Ray Street, Farringdon Road, E.C.* A letter addressed to either of the firms named would procure for you the information whether or not they would be willing to supply you with old type.

Patterns for Wood-Carving.

M. S. J. (*East Molesey*).—If you mean actual pieces of wood-carving for copying, I cannot tell you where such things are sold avowedly for your purpose. It might help you to pay a visit to the "School of Wood-Carving," in connection with South Kensington Museum. If, however, you merely require drawings as patterns, you may get these from Mr. Henry Zilles, 14, *South Street, Finsbury, E C.*, or from Messrs. Bemrose and Sons, *Old Bailey, E.C.*

"Enjalbert" Camera.

Lex.—The focussing screen of this camera is in a supplementary groove in the body of the camera.

Magic Lantern Slides.

Lathe.—I have a paper in hand on this subject, which will appear as soon as room can be found for it.

INFORMATION SUPPLIED.

Heliograph.

Casenhem writes in reply to W. S. M. (page 96):—"The following simple device should answer for such a short distance.

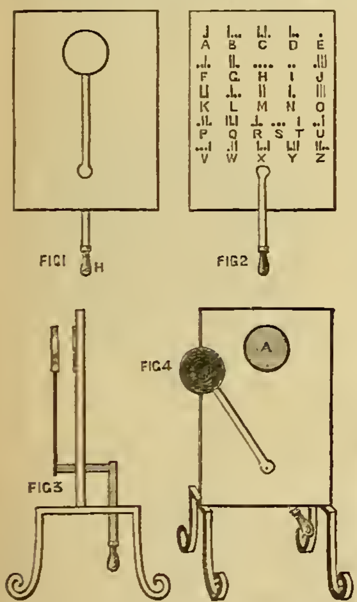


FIG. 1.—FRONT OF HELIOGRAPH. FIG. 2.—BACK, WITH CODE OF SIGNALS. FIG. 3.—SECTION OF HELIOGRAPH, ON STAND. FIG. 4.—PERSPECTIVE VIEW, SEEN FROM FRONT.

A piece of board about 1½ feet long by 1 foot broad and 1 inch thick, mounted on a stand or legs, as in Fig. 3. Near the top fix a mirror (a square one will do), as A, in Fig. 4. The mirror should face the distant station. Now arrange a shutter on a lever worked by the handle H. The diagram sketches should explain the rest. Fig. 1, front view, mirror covered by shutter; Fig. 2, back of board on which paste a paper, showing the morse alphabet; Fig. 3, side view; Fig. 4, front view, shutter deflected exposing mirror to off station. A reflecting mirror should be used to throw the sun's rays on to the fixed mirror A when shutter is deflected. This reflecting mirror should be hinged with ball or an universal joint for convenience of adjustment. For signalling set up each heliostat at their respective stations, so that each observer can see the other mirrors when exposed. Better signal the Morse alphabet. Example letter H is represented thus - - - - ; the handle would be deflected four times, leaving an interval between each dot of, say a second, *i.e.*, expose the mirror one second, pause one second, expose for next dot another second, and so on, and at the end of letter H pause a longer time, say four seconds; the off station seeing a longer pause, knows the letter is finished, and waits for the next, which, say is C, represented by |–|–, *i.e.*, dash expose three seconds, pause one; dot, expose one, pause one; dash, expose three, pause one; dot, expose one, pause four, as it finishes that letter. After a word is spelt, a longer pause must be given, and at first it will be better to signal one word, then wait for a signal from the other station to say if he has read it or not.

Synchroniser.

Casenhem writes in reply to An Old Subscriber (p. 144):—"To describe Barraud and Lund's synchronising system in all its details would take up too much space. I give a rough sketch of their method, from which you should be able to fit up your clocks. Messrs. Lund have only one standard, I believe, for setting the hands of some 500 or 600 clocks distributed about London. Their standard synchroniser is too complicated to be explained in this Magazine, and for your purpose a much more simple affair will suffice. Messrs. Lund's standard does a lot of funny things beyond merely sending the setting signal—things you would not require yours to do. Their standard once was forgotten to be wound up, and so failed to send signals; to prevent a future recurrence of this, a second clock was put in circuit, called 'Lobby,' and wound up on a different day to the standard, so that when the standard runs down, 'Lobby' takes to sending the time signals. There are some indicators such as follows: 'Standard' 'at work,' 'Lobby' 'shunted,' and 'Lobby' 'at work,' 'Standard' 'missed,' etc., etc., so that a glance at the indicators always shows what is going on. Your standard might have a disc of thin brass fixed on the minute wheel, having a pin in it with which to make contact (momentarily) each hour. For setting the hands an electro-magnet is placed behind each dial, the armature being pivoted, and held in its neutral position by the ball of brass, W. On the armature are two pins, A A and A′ A. Two levers are jointed at J J′. The shorter legs of the levers are slotted, as in Fig. 3, for the pins, A A, A′ A′, to slide in. At the extreme ends of the long legs of the levers are two other pins

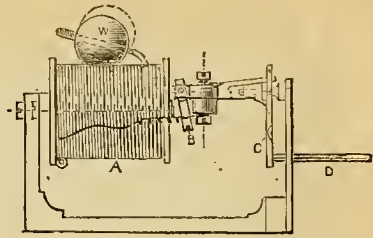


FIG. 1.—ELECTRO-MAGNET BEHIND DIAL. ELEVATION.

fixed, D, which protrude out of the semi-circular slot cut at the top of dial. When all is at rest, the pins, D, are clear of the end of the minute hand, and when a current arrives in electro-magnet from standard the armature is attracted, thus

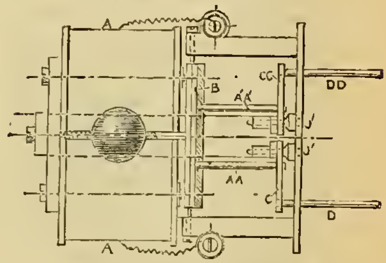


FIG. 2.—ELECTRO-MAGNET BEHIND DIAL. PLAN.

giving to the pins, A A, A′ A′, a downward motion, and with them the short arms of levers closing together in a finger and thumb motion, the long legs and the pins, D, thus grasp the minute-hand, whether it is two minutes before or after the hour, and

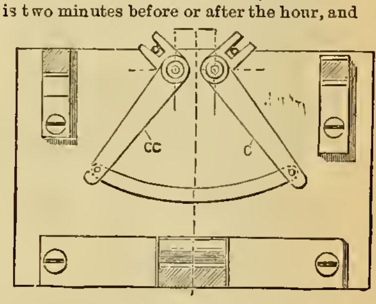


FIG. 3.—DIAGRAM SHOWING SLOTS IN LEVERS.

bring it to the hour dot. The current from standard being only momentary, the magnet loses its magnetism, allowing the ball to set the armature back, and with it the levers, pins, etc. More particulars if I can help you."

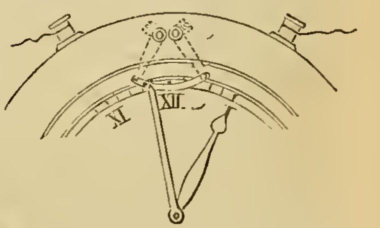


FIG. 4.—DIAGRAM SHOWING ACTION OF APPARATUS ON MINUTE HAND.

Watchmaking Tools.

T. M. B. writes in reply to F. A. E. (*Bailieboro*):—"I can recommend Messrs. Grimshaw and Baxter, 35, *Goswell Road, London*, who keep a large stock of tools for watch and clockmakers."

Mad Jack writes in reply to F. A. E. (*Bailieboro*):—"Write to Messrs. C. Gray and Son, 47, *Clerkenwell Green, London, E.C.*, for their catalogue, in which will be found everything that is wanted for the watch-maker's trade."

Casenhem writes:—"In reply to F. A. E. (page 192), watchmaking tools can be bought at Stockall's, 6 *and* 8, *Clerkenwell Road, London;* Swinden and Sons, *Temple Street, Birmingham*. I would advise you to get the box of Swiss-made drills, which are gauged in millimetric sizes, and are tempered in three degrees of hardness."

Addresses of Dealers in Fancy Woods.

Mad Jack writes in reply to Musjid:—"If you write to Messrs. Short Brothers, 256, *Old Street, St. Luke's, London, E.C.*, or Mr. George Pottier, 115, *Bethnal Green Road, London, E.*, enclosing stamp for price-list, I think you will get what you require, as they are foreign hardwood merchants." [I am obliged to you for your note on "*Arbor Dianæ*," but the mode of forming it is well known.—Ed.]

INFORMATION SOUGHT.

Nickel-Plating Tricycle.

J. C. T. wishes to know how to nickel-plate a tricycle. [Mr. Edwinson is under an engagement to give instructions in nickel-plating. I fear, however, that you as an amateur, would scarcely be able to carry out the process for so large an article as a tricycle.—Ed.]

Organette and Autophone.

F. P. (*Andover*) wishes for instructions for making a really cheap and serviceable "organette" and organette music papers; also "autophone" and papers.

Emery Wheel.

F. A. E. (*Bailieboro*) writes:—"Will some of my brother amateurs kindly inform me how to make a solid emery wheel?"

Knife Handles.

F. A. E. (*Bailieboro*) asks:—Is it possible to restore bone knife handles which have got yellow owing to use to their former whiteness, and if so, what will do it?

Pockets in Billiard Table.

Casenhem writes:—"Living as I do 'far from the madding crowd,' I find putting new billiard cloth on very tedious. I should esteem it a great favour to be enlightened as to the mode of fitting the cloth on centre pocket holes, and the method adopted by professional billiard table coverers of levelling the table."

Model Gun Carriage.

A Reader from the First writes:—"Will somebody kindly give me the necessary instructions and diagrams to make a model (with the appendants) of the 81 ton or 101 ton gun and carriage? I have neither the patterns nor castings. Would you kindly advise, also, whether it should be made all of metal (preferable to myself gun-metal). I know how to use tools, and should like a perfect model in every respect. About 5 inch would be long enough for the gun. I should finish the whole concern off very highly, and place it under a glass case which I shall make for the purpose." [Please adopt a shorter nom-de-plume. It is not within my purpose to give instructions for "a model lathe, a model gun battery, a model workshop," etc. You must kindly be content with the models that Mr. Pocock will give in his papers on "Model Engine Making."—Ed.]

Artist's Three-Legged Chair.

J. L. D. (*New Quay*) wishes for a design for an artist's three-legged chair, "opening and closing like an umbrella."

Wood from Old Almanacks.

A Reader from the First writes:—"I have a lot of O. G. pieces of wood taken from Metchim and Son's almanacks. They are all covered in gold, and I think I might turn them to account, in the shape of picture frames of an artistic nature. Will somebody kindly oblige by giving me their help in any shape or form, so that I might turn them to account for the most useful purpose." [I am afraid the pieces of gilt moulding from almanacks that you have are scarcely worth the trouble of making into picture frames. For this purpose you had better purchase new mouldings.—Ed.]

Lapidary's Bench, etc.

Lap writes:—"I should be very thankful if any of our contributors could tell me if it is possible to fix laps and slitters to an ordinary lathe, or if it cannot be made to answer well I should be glad of a rough design for a lapidary's bench. I should like the top to take off, and the supports to be made to go into as little room as possible. I also think articles on the subject would be well received by readers generally."

Ticket and Show-Card Writing.

Aspirant writes:—"Will some reader please inform me as to what paint is best for the above work, as also the name of the most suitable card, and where such can be bought in small quantities cheap. How to get the gloss and finish to the paint and any little hint that may be useful."

Walking Sticks of Steel Ribbons.

Lex asks:—"Could any reader tell me where to buy the walking sticks of steel ribbons, shown in the French department at the "Inventions," also their price. In the "Year Book," 1886, of "Photographic News," there is a suggestion by Mr. Cobb to use three of these sticks for a tripod, by fastening their heads to the tripod head. Would Mr. Pocock or any other reader kindly give me some hints as to the best manner to utilize these steel ribbons for a tripod? I might remark that the stick folds up into six inches.

Norwegian Gimlet.

Goldsmith asks:—Does anyone know where the Norwegian gimlet can be bought, and what its principle is? It is said never to split the wood. [I only know three forms of gimlet myself that are used in carpentry, and these are the shell gimlet, the twist gimlet, and the auger gimlet. Any ironmonger will show you these, and on examining them you will at once see their principle. It is possible that someone may have spoken to you of the twist gimlet under the name you mention above. Still, if there be such a tool as the Norwegian gimlet, I shall be glad to hear something about it.—Ed.]

Shoemaker's Wax.

J. L. D. (*New Quay*) wishes for a good recipe for making this material.

Tinning Cast Iron.

G. L. G. writes:—"I have a casting for a washing-machine which I should like to be coated with tin. I have tried the directions given in Vol. IV., page 455, without success, as it got a tarnished appearance on it when put into the bath of metal, and the metal got into little beads or balls. Any information as to what I ought to do will be helpful, or if anyone can recommend a substitute for tinning that would stand hot water, and prevent the iron from rusting."

Smoke Pictures.

Mad Jack asks:—Can anyone tell me how to make smoke pictures?

Cone Work.

Mad Jack asks:—Can anyone tell me how to do cone work?

Harp Making.

Harpist writes:—"I shall be glad if any reader of Amateur Work will give me any information as to making the soundboard and body of a harp, and the proper woods to use, or refer me to some book on the subject. I have an old body to copy from, which is too much worm-eaten to be of use, and I have all the action, pole, etc., belonging to it. The prices charged by makers are quite beyond my reach.

Hydraulic Ram.

T. B. asks:—Will some one kindly give me instructions for constructing a hydraulic ram?

Chromograph, etc.

J. H. W. writes:—"Can anyone give me a recipe (which he has himself tried) for making a chromograph, hectograph, or multigraph?"

Pantograph.

J. S. (*Redditch*) wishes for a sketch of a pantograph from which he might construct one for a small sum.

Medium for Making Photographs Transparent.

J. S. (*Redditch*) asks:—Can anyone tell of a good medium for rendering transparent photographs mounted on glass for crystoleum painting. The medium sold at artists' shops is good, but far too dear for the shallow pockets of a poor parson.

COMMUNICATIONS AWAITING REPLY

Hong Kong; W. F. S. (*Leicester*); Bingo; A. H. M. (*Newtownards*); J. F. T. Bailey; E. H. (*Shrewsbury*); E. L. (*Esholt*); Modus; F. P. (*Andover*); J. Y. (*Uxbridge*); H. D. (*Cambridge*); J. B; Scotus; S. M. L. (*Goderich, Canada*); J. H. S. (*Manchester*); R.J.P.; Caw-caw; W. H. R.; S. W. G. (*Peckham*); R. A. W. (*Dublin*); A. B. C.; Stadt Dresden; W. C. (*Dumfries*); Curler; Mad Jack; H. H. D. B.; Cincinnatus; Clenicus; Pitchpine; F. Y. G.; E. L.; Plane Iron; F. J. C.

DRY-PLATE PHOTOGRAPHY:

THE GELATINO-BROMIDE PROCESS.

By C. C. VEVERS.

III.—SELECTION OF APPARATUS—THE CAMERA—PHOTOGRAPHIC OPTICS—LENSES.

IN this chapter we shall deal with the apparatus proper—that is, the apparatus used solely in the action of taking the photograph; the materials used in finishing the photographic picture I will enumerate at the head of their respective departments. This apparatus is, of course, the most particular and by far the most expensive that will be required by the

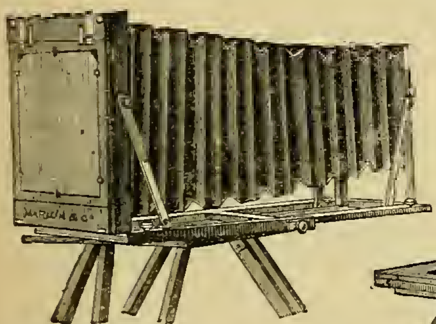


FIG. 16.

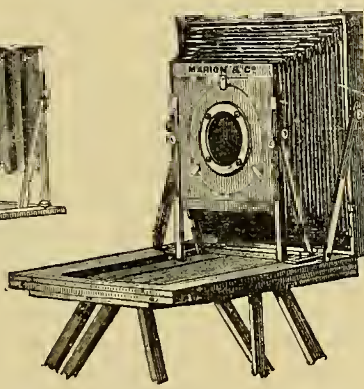


FIG. 15.

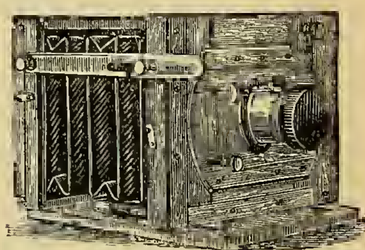


FIG. 17.

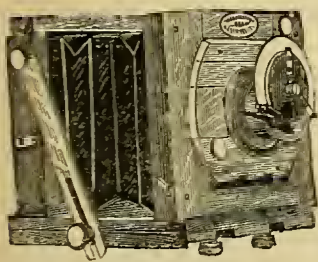


FIG. 18.

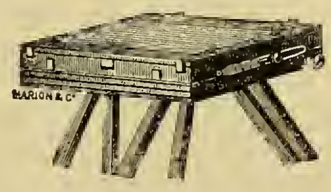


FIG. 13.

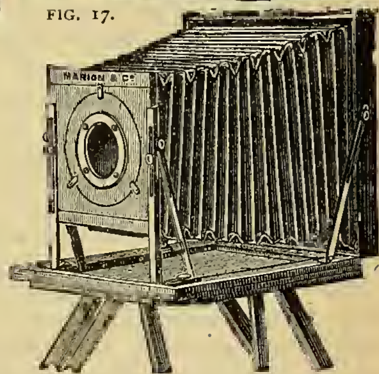


FIG. 14.

FIG. 13.—MIDDLEMISS' PATENT CAMERA, CLOSED. FIG. 14.—CAMERA ERECTED. FIG. 15.—CAMERA AT SHORT FOCUS. FIG. 16.—CAMERA EXTENDED. FIG. 17.—LANCASTER'S "INSTANTOGRAPH." FIG. 18.—LANCASTER'S "LE MERITOIRE."

amateur, who should consider carefully the largest amount of money he is prepared to expend, the size and style of the picture he intends to take, and the many other questions which will confront him, before purchasing. With some amateurs the former is a matter of no question, while others may be tied down to a certain sum.

The subjoined table shows the English standard sizes of plates, and all English-made cameras are constructed to work with one or other of these sizes:—

	Inches Square.
Optical Lantern size	$3\frac{1}{4}$
Stereoscopic „	$6\frac{3}{4}$ by $3\frac{1}{4}$
$\frac{1}{9}$ or Ninth-Plate „	$2\frac{1}{2}$ by 2
$\frac{1}{6}$ or Sixth-Plate size	$3\frac{1}{4}$ by $2\frac{3}{4}$
$\frac{1}{4}$ or Quarter-plate „ (Carte-de-Visite) .	$4\frac{1}{4}$ by $3\frac{1}{4}$
$\frac{1}{3}$ or One-third-Plate „	5 by 4
$\frac{1}{2}$ or Half-Plate „ (Cabinet)	$6\frac{1}{2}$ by $4\frac{3}{4}$
$\frac{1}{1}$ or Whole-Plate „ (Imperial) . . .	$8\frac{1}{2}$ by $6\frac{1}{2}$

Larger sizes are also manufactured, as follows:—

10 by 8 inches.	18 by 15 inches.
12 by 10 „	24 by 18 „
15 by 12 „	30 by 26 „

The amateur must now determine the size of camera he wishes to buy, as all his other apparatus must be of a similar size. The advantage of a small size must be obvious—prominently, cheapness, compactness, and lightness; while I consider the disadvantages to be very few, that of the smallness of the photograph produced being the greatest. Certainly I should not advise the beginner to purchase a camera larger than for half-plate (cabinet) pictures; the quarter-plate is very popular amongst beginners, and is a very useful size; but when the amateur has gained some little experience he invariably wishes to soar into higher fields and take larger pictures. The small set is then given away, or sold at a considerable loss, and a larger set purchased. This, no doubt, is the best thing that can be done by those whose luck it is to be well stocked with "the needful," and with whom a few pounds more or less is of little consequence; but I think the majority of my readers will

find it a true economy to obtain a half-plate set at the outset, as, with the addition of what is known as a "carrier" to his dark slide, he may at any time take smaller pictures, thus reducing his expenses, as regards plates and chemicals, to the same amount as if he were working with a smaller camera. But do not sacrifice quality for size. Do not, if you are limited to a certain sum, get a cheap, badly-constructed half or whole-plate set, when, with the sum expended a good, well-made quarter plate set may be obtained.

A camera, to be perfect, should combine all the following qualities, movements, etc. :—

1. It should be strong and carefully made of good well-seasoned wood (Spanish mahogany is best), so as to be perfectly rigid when fixed up; a shaky camera can never be relied on.

2. It should be light and compact.

3. It must be easily erected and folded, and should be devoid of loose screws, struts, etc.

4. It should have a good leather bellows body.

5. It should be fitted with some simple arrangement to allow pictures being taken either in a vertical or horizontal position. What is known as a "reversing frame" is best for this purpose.

6. It should have either rack and pinion or screw adjustment for focussing.

7. It should have a double swing back; and,

8. A sliding front, having a vertical and horizontal movement.

I will now describe the various properties of a good camera more fully.

The Bellows.—The body of a camera used for landscape photography is now always made in the form of a bellows or concertina body, for lightness, and to allow of its being folded into very small space. In cameras built for use in the studio, portability is not so essential, and the body of the camera is often made of wood, in the shape of two boxes—one sliding inside the other. The bellows should be made sufficiently long to extend between two and three times the length of the largest plate to be used. Thus in a quarter-plate camera the bellows should, when drawn out to their fullest extent, be about 11 or 12 inches long; and in a half-plate camera, about 16 or 18 inches long. This allows for using very long focus lenses, and is extremely serviceable when copying. The bellows—or rather the camera—when at its shortest focus, should allow the ground glass to reach within 2 or at most 3 inches from the front of the camera.

The Reversing Frame.—Before this arrangement was introduced, to take a vertical picture the camera had to be turned completely on its side, or the position of the plate in the dark slide had to be changed. This was very objectionable, and caused much inconvenience and loss of time. By the use of a reversing back, the slide (and with it, of course, the plate) may be adjusted in either position almost immediately.

The Swing Back and Sliding Front.—Of the uses of the swing back and rising front I shall speak more fully at a future date; let it suffice here to say that the swing back is a movement given to the back of the camera, by which the top or bottom alone may be moved nearer the lens, or *vice versa.* Many cameras have a "double swing," by which, in addition to the top or bottom, either of the sides may be brought nearer the lens. The sliding front permits the front of the camera carrying the lens being moved upwards or from right to left, so as to bring the object on to any part of the ground glass without tilting or twisting the camera.

The Rack and Pinion and Screw Adjustment.—These are the two most usual methods used for bringing the ground glass nearer or further away from the lens—"focussing" it is called. In some cameras the movement is given to the back of the camera, in others the front it is that moves; again, in some either back or front may be moved. When a rack and pinion is employed, the rack is attached to a sliding frame in the camera bottom, the pinion to the baseboard. To this sliding frame is fixed the front or back (the end to be moved) of the camera, so that, on screwing a milled head the pinion works over the rackwork, and of course moves the rack and camera backwards or forwards as desired. The screw adjustment, as its name implies, is a long continuous screw working through a "bush" in the end to be moved, which is drawn backward or forward on the screw being turned by a small handle at the back of the camera.

The Dark Slide.—There are two forms of double dark slides; in the one, one of the shutters may be drawn far enough out to allow the first plate to be laid on four brass pins, film side downwards, then follows the central division, which is usually made of tin or thin zinc with a small brass spring attached to one side; it is laid with the spring resting on the back of the first plate; the other plate is next inserted film side upwards and secured by the small brass buttons, when the shutter can be closed. The other slide opens in the centre in the form of a book, the plates are inserted as in the previous case, the empty side shut over the one containing plates and division, and secured by brass hooks at the outside. The latter form of slide is perhaps the best, but both answer quite satisfactorily if well and perfectly made. Before using a new set the dark slides should be tested by inserting sensitive plates as usual, and exposing the slide to the sun for about half an hour. The plates must afterwards be carefully developed, if the slides are perfect they will show no signs of fog.

Carriers.—With the dark slides should be supplied a set of inner frames, or "carriers," as they are technically termed, by the use of which a plate smaller than the one commonly taken in the dark slide may be used. For instance, in a balf-plate camera, by the aid of a carrier a quarter-plate may be exposed. Carriers are simply frames made of thin wood or zinc, the outside measurement the size of the plate tbe dark slide takes, with an opening the size of the plate intended to be used ; across each corner is fastened a small piece of wood, zinc, or silver wire to support the plate. They are very easily made, and if the amateur is not supplied with a set, he can, without difficulty make some himself. Fig. 19 shows one of tbese carriers with measurements for a quarter-plate to be used in a half-plate slide.

The camera I would advise the amateur to purchase, and the one which I consider from personal experience to be the best in the market, is that truly ingenious invention of Mr. William Middlemiss of *Bradford*, *Yorks*. This camera, which comprises several improvements, is especially constructed and adapted for field work, and has been planned to embrace all the possible ameliorations and advantages that can be desired in a modern camera. By a few illustrations, my readers will readily discern the advantages to be obtained in this camera over others, and some of these I will now point out. It has great strength and rigidity, yet it is comparatively light—a half-plate camera and three double backs weighing only 6lbs. It is compact : the same camera, *inclusive* of tbree double backs measuring, when closed, but 8½ by 9½ by 5 incbes. It has a good length of focus, wbich is adjusted by means of a rack and pinion ; the opacity of the bellows is undoubted, being composed of one thickness of best leather, one of *yellow* paper, and two of black twill ! yet it is light and folds remarkably easily. The front has a large amount of rise and fall, and the bellows being secured to the rising part, there can be no chance of cutting off a part of tbe picture on account of the conical form of the bellows. There is a simple arrangement for cbanging the lens if required : in the camera front is cut a circular hole, into which fits—in a manner perfectly light and tigbt—a piece of wood to which the lens flange is attached. With every camera two of these circular pieces of wood are supplied, so that the amateur if he wish to use two lenses, will not, as of old, be obliged to unscrew one flange, and screw on another (a proceeding, I have always found an infinite trouble when in the field), but by simply having the flange of each lens screwed to a separate piece of wood, he has but to remove the one and insert the other when the desired change is effected. Each camera is fitted with a double swing back with independent motions—that is, a horizontal and vertical movement for altering the angle between the ground glass and the axis of the lens ; and also with a reversing frame, the camera itself being essentially square. The amateur will find the focussing screen attached to ordinary cameras very troublesome when folded back for the insertion of the dark slides ; in Middlemiss' camera, however, it is not necessary to turn the focussing screen over the camera, but, being hung with double-jointed hinges, it need only be pulled off a little and the dark slide inserted. The dark slides are of the book form, and have double joints so that the shutter may be folded round the camera back when drawn out. Each shutter is also provided with a small brass spring, which automatically fastens the shutter when it is pushed back into its place after exposure, and must be pressed to again withdraw the shutter, thus preventing any possibility of accidentally opening the slide.

The whole is as simple and efficacious in manipulation as it is ingenious and perfect in its construction.

Fig. 13 shows the camera closed, but screwed on the tripod ready for opening. By a simple turn of the set screws at the side, the camera may be opened, when it will be in a position as shown in Fig. 14. Here we have another advantage ; in this camera there is not a loose screw, nor is it necessary to detach any part to open or close the apparatus, consequently there is nothing to get lost. Fig. 15 shows the camera at its shortest focus, and Fig. 16 represents it at its longest extension.

The tyro should see the camera to fully appreciate its various qualities, and I have no doubt Messrs. Marion and Co., who are sole agents for its sale, would be only too pleased to explain the movements to anyone who cares to call at their establishment in *Soho Square*. The price for a half-plate camera and three double backs is £8.

Mr. Middlemiss, who is an extensive manufacturer of photographic apparatus for the trade, has kindly offered to supply any reader of "ours," who may wish to construct his own camera with all the necessary materials, including the requisite brass and woodwork, at a very moderate cost ; those amateurs who are gifted with a "tinkering" propensity, should write for his price list of photographic sundries.

Messrs. J. Lancaster and Son, *Birmingham*, also supply very cheap cameras, which, although not to be compared with the above, are fairly well made, and give good value for the money. An illustration of their "Instantograph" is given in Fig. 17, and one of their "Le Meritoire," in Fig. 18. The price of the former, including lens, instantaneous shutter, double back and tripod, is, for half-plate size, £4 4s. ; for the latter, I think, £3 3s.

I have had the pleasure of examining the guinea set of apparatus lately introduced by Mr. Jonathan Fallowfield, 35 and 36, *Lower Marsh*, *Lambeth*, *S.E.* It is astonishing how such a complete and really well made set can be manufactured and sold for the very low sum charged. The set includes a square camera for quarter-plates, fitted with *reversible frame*, rising front, bellows body, one double back, strong folding tripod and lens—all for the very modest sum, 21s. For cheapness, portability, and simplicity, I must say this set defies competition. Mr. Fallowfield will supply extra double backs for this camera at 6s. each.

The Lens.—The lens is undoubtedly the most important and particular part of the amateur's kit, and great discretion should be used when purchasing it. With the many different kinds of lenses and the great variation in prices and quality, although the external appearance may be exactly similar, the beginner is apt to find a difficulty in securing a suitable one; I therefore think a few words on the various kinds of lenses will not be out of place.

There are several forms of lenses, each of which gives a different quality of direction to the incident ray of light proceeding from any object. The various shapes are shown in Fig. 21.

When a ray of light passing through air comes in contact with a medium more dense than air, the ray is bent or refracted out of the course which it originally pursued. Here is an interesting experiment to prove this effect. Suppose in Fig. 20, A to represent a basin, at the bottom of which is placed a small object—say a coin B. Now, the conditions being such, and an

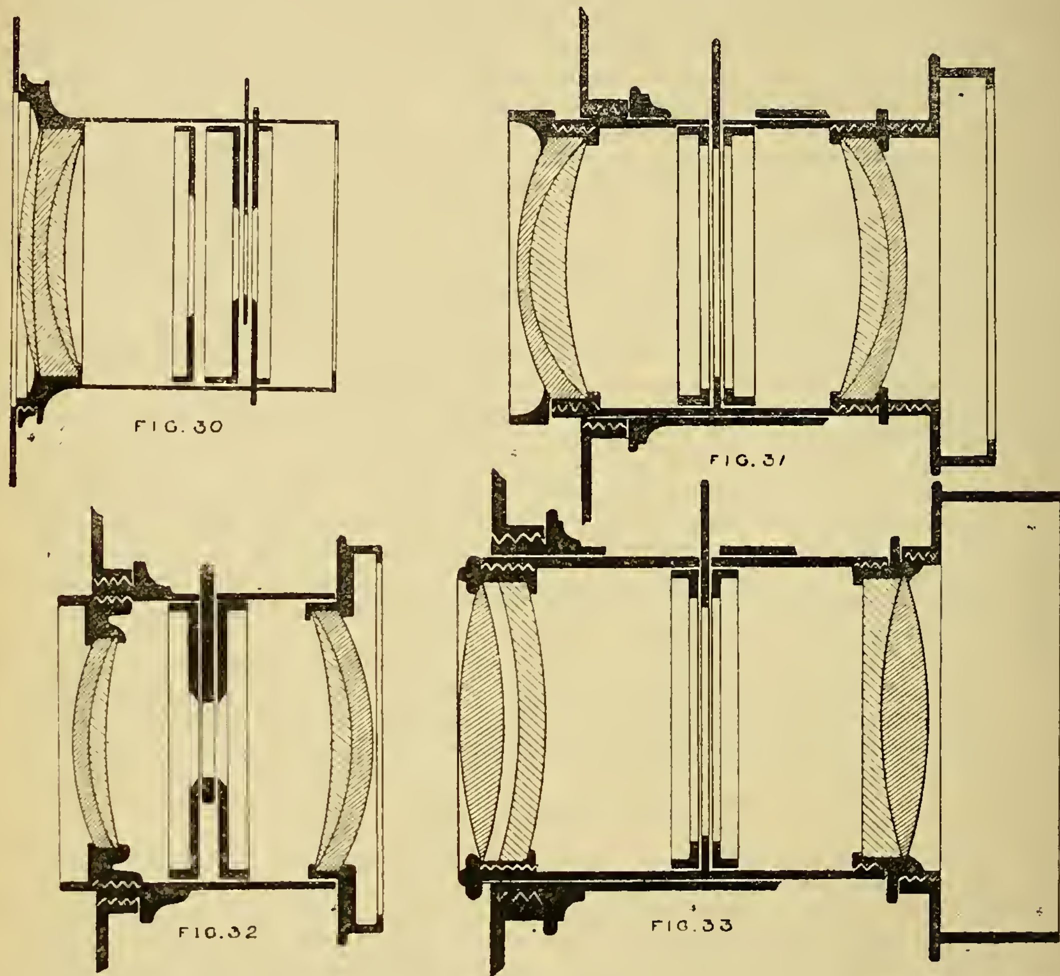


FIG. 30.—SINGLE COMBINATION LANDSCAPE LENS. FIG. 31.—DOUBLE COMBINATION RAPID LANDSCAPE LENS. FIG. 32.—WIDE ANGLE LENS. FIG. 33.—PORTRAIT LENS.

In the sections of lenses exhibited above the dark shading represents flint glass; the lighter, crown glass.

observer being placed as represented by the eye, the coin will be invisible because the ray of light C C, will impinge on the side of the basin, A. If, however, water be now poured into the basin (all other conditions remaining exactly the same) the coin will be made visible, simply because the water has the property of refracting or bending the ray C C, from its original course. As another instance we will suppose A (Fig. 22) to be a sheet of plate glass, and B the ray of light. It will be seen that on entering the glass the ray of light is bent towards the normal or perpendicular to the surface, but, on emerging, it is bent away from the normal, and proceeds in a course parallel to, but not coincident with, its original direction. But if the ray of light entered the medium perpendicularly, or at right angles to its surface, it would pass straight through without suffering any refraction, as shown by dotted line C D. When, however, the ray passes through some medium, the surfaces of which are not parallel, the ray is permanently bent to one side. Take, for instance, a glass prism A (Fig. 23). The ray is refracted at both surfaces; on entering and on leaving the prism, so that an object really at B would appear to be at *b*;

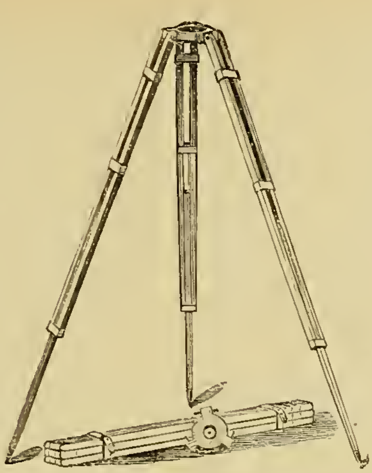


FIG. 34.—TRIPOD OR CAMERA STAND.

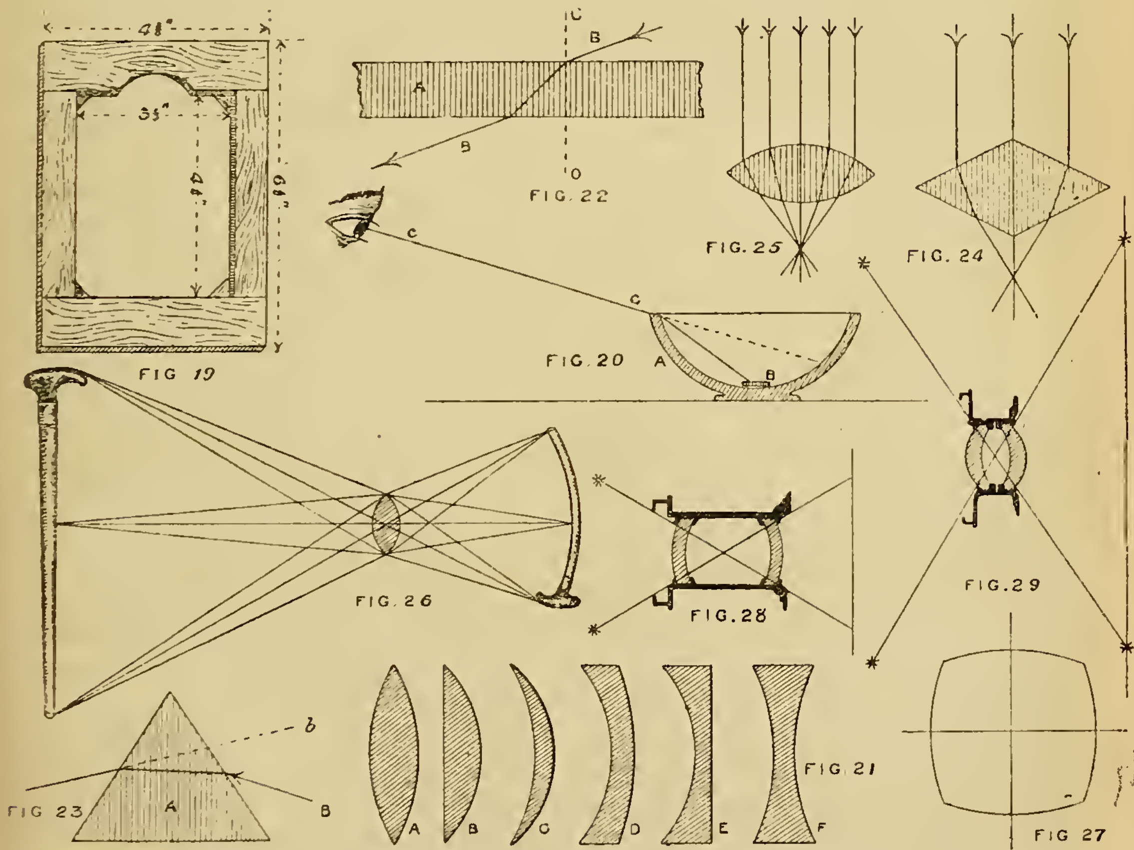


FIG. 19.—INNER FRAME OR CARRIER—one-fourth full size. FIG. 20.—DIAGRAM ILLUSTRATING REFRACTION. FIG. 21.—LENSES—A, Double or Bi-convex; B, Plano-convex; C, Concavo-convex; D, Meniscus; E, Plano-concave; F, Double Concave. FIG. 22.—DIAGRAM ILLUSTRATING REFRACTION OF RAY PASSING THROUGH PLATE GLASS. FIG. 23.—DIAGRAM ILLUSTRATING REFRACTION OF RAY THROUGH PRISM. FIG. 24.—DIAGRAM ILLUSTRATING REFRACTION OF RAY THROUGH TWO PRISMS PLACED BASE TO BASE. FIG. 25.—DIAGRAM ILLUSTRATING REFRACTION OF RAY THROUGH BI-CONVEX LENS. FIG. 26.—DIAGRAM ILLUSTRATING ROUNDNESS OF FIELD OR SPHERICAL ABERRATION. FIG. 27.—DIAGRAM ILLUSTRATING DISTORTION OF SQUARE. FIGS. 28, 29.—DIAGRAMS ILLUSTRATING DIFFERENCE OF ANGLE INCLUDED BY NARROW AND WIDE ANGLE LENSES RESPECTIVELY.

and, of course, if we place two prisms base to base (Fig. 24) the rays, before parallel, will meet in a point. If we substitute for the two prisms a double or bi-convex lens, we have the same result, as shown in Fig. 25. The spot at which the ray of light comes to a point is called the "focus" of the lens. If, however, a double convex lens were used in photography *alone*, it would necessitate the use of spherical, or concave, plates and ground glass, as those rays striking the lens obliquely or along its axis, will not come to a focus on the same plane as other rays striking the lens parallel to the axis (at right angles to the general direction of the lens). In Fig. 26 this defect, which is called "roundness of field," is shown. The rays passing through a double convex lens from a straight walking-stick, an inverted image of the stick is formed, but in a curved shape. This defect, however, is almost wholly overcome by using a combination of two or more lenses of different shapes. Lenses are made of different complications, and are, consequently, suitable for different kinds of work, such as portraiture, architecture, landscape, etc.

I illustrate, in section, one or two of the most useful and well-known types. Landscape lenses generally take the *meniscus* form.

The Single Lens.—This is the simplest and cheapest form of lens, and is the most useful for landscapes "pure and simple." The best form of this lens is a combination of a meniscus flint lens cemented between two crown concavo-convex lenses. Such a lens is rapid, and will include a fairly wide angle; it is, however, unsuitable for photographing buildings, etc., as it gives slight "distortion," or curvature of the boundary lines.

The Rapid Landscape Lens.—This is an exceedingly useful lens, and the one I recommend the amateur photographer to buy. It is very rapid, being the lens most suitable for instantaneous effects, it covers an angle of about 60°, and is free from distortion. It is formed by a symmetrical pair of flint and crown glass lenses, the concave surfaces of the lenses facing each other. The most popular forms of this lens are the "Rapid Rectilinear," manufactured by Dallmeyer and the "Rapid Symmetrical," by Ross.

The Wide-Angle Lens.—This doublet lens is made with the lenses very close together, so as to cover an angle of about 90°. Their only use is for taking pictures in confined situations—such as interiors—where it is impossible to get far away from the object to be photographed, as, in consequence of the very small aperture, these lenses are very slow. Fig. 32 is an illustration of the "Wide-angle Rectilinear" and the "Wide-angle Symmetrical, manufactured by Dallmeyer and Ross respectively.

The Portrait Lens.—Fig. 27 illustrates the most common type of portrait lens. They are always of the double form, and are usually composed of two double convex crown lenses, and one plano-concave, and one meniscus lens of flint glass. Being constructed with a view for great rapidity they are five or six times as rapid as the quick-acting landscape lenses. They are very unsuitable for any other kind of work than that for which they are constructed, and are, therefore, of little use to the amateur, who will be able to take all the portraits he may require with his landscape lens.

Several technical terms applied to lenses here need a little explanation.

Aperture is the opening in the diaphragm or stop, or where no stop is used, it is the opening of the smallest combination of the lens that admits the light. The term "open aperture," is applied to the opening of a lens when all the stops have been removed.

Chromatic Aberration.—As the reader has already learnt, the light proceeding from the sun is composed of rays of various colours, which, in combination, form white light. On passing a ray or pencil of white light through a glass prism it is decomposed, as was explained in Chapter II. This effect is often to be seen in single lenses, the blue and violet, or actinic, rays coming to a focus at a point nearer the lens than do the illuminating rays. To overcome this defect, lenses made of different varieties of glass (the dense flint glass containing oxide of lead, and the light crown glass) are combined, so that the different coloured foci may be united in the same point on the axis. Lenses thus formed are termed "achromatic."

Combination.—Combination is a term applied to a lens which is composed of two or more lenses cemented together, but apparently one solid piece (Fig. 30).

Depth of Focus is the power of the lens to represent *sharply* on the ground glass objects near and at a distance at the same time. The smaller the stop used the greater will be the depth of focus.

Distortion is a defect produced by some lenses much more than others, and is particularly apparent in single lenses. Distortion causes straight vertical or horizontal lines to curve outwards after the manner of a barrel, as in Fig 27.

The Focal Length, or *Focus*, as it is more commonly called, is the distance from the lens in single lenses, and from the stop in "doublets" to the ground glass when the image is in sharp focus. The principal focus of a lens is, briefly, the point where the rays which enter parallel meet on emerging.

Spherical Aberration is the term exclusively employed to denote the aberration produced by the refraction of a ray at a spherical surface; that is, the ray of light passing through some lenses is refracted unequally at different parts of the surface of the lens, those rays

which pass through the edges of the lens being refracted the most and come to a focus at a nearer point to the lens than do those passing through the centre. This defect is overcome to a certain extent by placing a stop before the lens, thus cutting off those rays which fall upon its circumference, but making it much slower in action.

Width of Angle is the amount of view covered by the lens. If we obtain a picture on the ground glass with an ordinary view lens, and then change it for a wide angle lens of the same length of focus, it will be found that the wide angle lens will show a picture on the ground glass which includes objects extending several yards to either side that were left out when the narrow angle lens was used. Figs. 28 and 29 will give some idea of the difference in action between a wide and a narrow angle lens. A wide angle lens is not, however, to be recommended for general use, as, owing to the surface of the lenses being ground to include a very wide angle, it will not give definition towards the extreme edges of the plate, unless a very small stop be inserted, which will, of course, make the lens proportionately slow.

I have not space here to deal more fully on optics, but must say it is a branch of the art the uninitiated should particularly study before purchasing his lens, and, above all, when he *does* purchase one let it be a good one, and as a double security let him go to a well known maker and pay a fair price for one, for with all the most elaborate and highly-finished cameras in the world and a lens of inferior quality, he will not be able to produce a *good* picture. For the varieties of photography the reader is likely to indulge in, I would recommend either Dallmeyer's "Rapid Rectilinear," or Ross' "Rapid Symmetrical," costing respectively for half-plate pictures, £5 10s. and £5 5s. The equivalent focus of the former is about 8½ inches, and of the latter 7½ inches. They can be obtained from *any* photographic dealer—Fallowfield, for instance—and are subject to discount of 10 per cent. for cash.

As I have actually seen the question asked more than once in the photographic journals, I may as well state for the benefit of one or two readers that a lens made to cover a certain sized plate will cover equally well, or better, any *less* size: thus, the lenses mentioned above can be used for 5 by 4, and quarter-plate pictures if required.

The Tripod, or camera stand, requires no description, as I have no doubt it is already a familiar object to every one. It should be light, but at the same time strong and rigid. It should have adjustable sliding legs for working on uneven ground (Fig. 34), and I prefer those with wooden heads, so as to do away with the "triangle," which is always getting misplaced. Fallowfield sells a good one, the cost of half-plate size, weighing 2 lbs. 10 oz., is 14s. 6d.; but the best in the market is Kennet's screwless sliding stand; the price of this tripod varies considerably with different dealers. Fallowfield supplies the half-plate size at 17s. 6d., while, for the same size another firm charges 23s.

The Focussing Cloth is used for covering up the head and greater part of the camera when focussing, so as to exclude all light from the ground glass except that which passes through the lens, enabling the operator to see the image on the focussing screen much better. It may be made of one thickness of black velveteen and one of black twill, and should measure about 4 feet 6 inches square.

For instantaneous photography a shutter will be required. There are so many very excellent drop shutters now made that I really cannot particularise any one. A good one could be bought for about 17s. 6d., but I do not see why the amateur should not make his own; space does not permit of a description of one in this paper, but in the chapter on instantaneous photography, I will give working drawings for a shutter I have found very efficacious yet simple.

(*To be continued.*)

AN ELECTRIC ALARUM FOR SOUND SLEEPERS.

By PROFESSOR L. MARISSIAUX.

(*Translated from the French by* JOHN POCOCK.)

I HAVE possessed an alarum these ten years. What was the cause of it I do not exactly know, but at any rate about six months ago this alarum of mine began gradually to produce less and less impression upon my organ of hearing, till at last things came to such a pass, that in spite of the bell I continued to sleep, as the French say, "on both my ears," though this would certainly appear a somewhat difficult achievement. I *heard* the alarum, certainly, but it was in a sort of drowsy reverie, half-way between sleeping and waking, and its sound being quite inadequate to rouse me, I fell fast asleep again the moment it ceased. At length I resolved to end this state of things, which had several times caused me to put in a late appearance on the scene of my day's occupations, a very disagreeable result to one who loves punctuality.

The following is an account of how I managed it: My old alarum was one of those cheap affairs with an enamelled dial-plate, steel hands, and a brass case, having two keys at the back, one for the alarum and one for the movement, these keys serving a second

purpose in fixing on the back, which conceals the works and protects them from the dust.

The metal box containing the works served also as a bell. [" La boîte en métal dans laquelle est enfermé le mouvement servait en même temps de timbre."]

This alarum I had enclosed in a sort of box, shaped like a small châlet (Fig. 1), which showed the face in front, the piece of wood at the back, Fig. 2, being pierced with a hole, A, by which to hang it up.

My intention was to transform this ordinary the box enclosing the alarum, is attached to a spring, B, which is itself fixed upon the outside back of the wooden box, and entirely insulated from the metal plate which forms the back of the alarum. We shall presently see the use of this spring.

My electric alarum is now ready to act, but it must be wound up every day; and now we shall see the use of the small board A, Fig. 4. It is made of common wood, and furnished with two brass plates, *a* and *b*. The plate on the left, *a*, when the alarum is hung on the hook *c*, ought to correspond with the

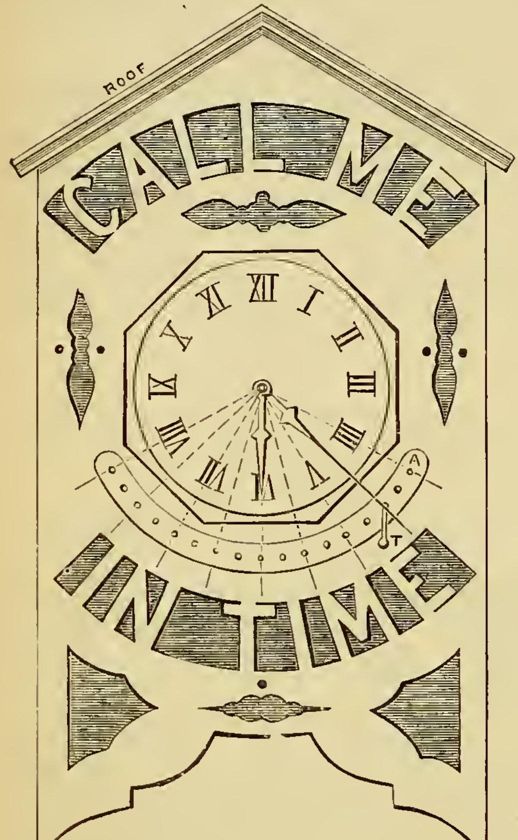


FIG. 1.—FRONT OF CLOCK.

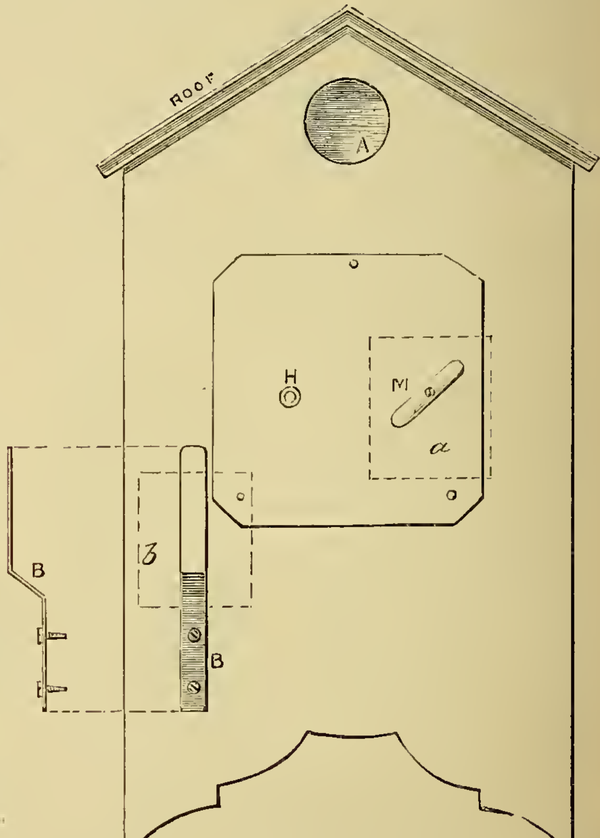


FIG. 2.—BACK OF CLOCK.

alarum into an electric alarum. To begin with, I did away with the key H, which served to wind up the alarum (see Fig. 2); I then soldered on to the hour hand a thin and narrow slip of brass, just long enough to touch a small peg T, fixed on the brass piece A, which is itself attached to the wood, and therefore insulated (Fig. 1). This semicircular piece A is provided with small holes, into which the peg T fits tightly. These holes are so placed that they correspond with the hours, half hours, and quarter hours of the dial-plate, as shown by the dotted lines, Fig. 1. A wire starts from the piece of brass A, and passing through key of the movement, and make a good connection with it; while the plate *b*, Fig. 4, serves as a fulcrum for the spring B (Figs. 2 and 3). Fig. 5 shows the position of the alarum, of the bell, and of the battery.

We must not omit to remark that the hook C must be long enough for the alarum to hang straight, and also to allow the key M, Fig. 2, and the spring B, to rest upon their respective plates, *a*, *b*, of Fig. 4.

It will be easily seen that when the hour hand (in this case the longest) touches the peg T the bell will sound, and will continue to sound as long as one does

not remove the peg T. In order to compel the slumberer to arise, I would suggest that the clock should be placed at a considerable distance from his couch, and the bell as near it as possible. The clock might even be left downstairs, or in an adjoining passage, in order to deprive the sleeper of his longing to bury himself anew beneath the blankets. If he does not get up at once to remove the peg T, not only will the bell con-

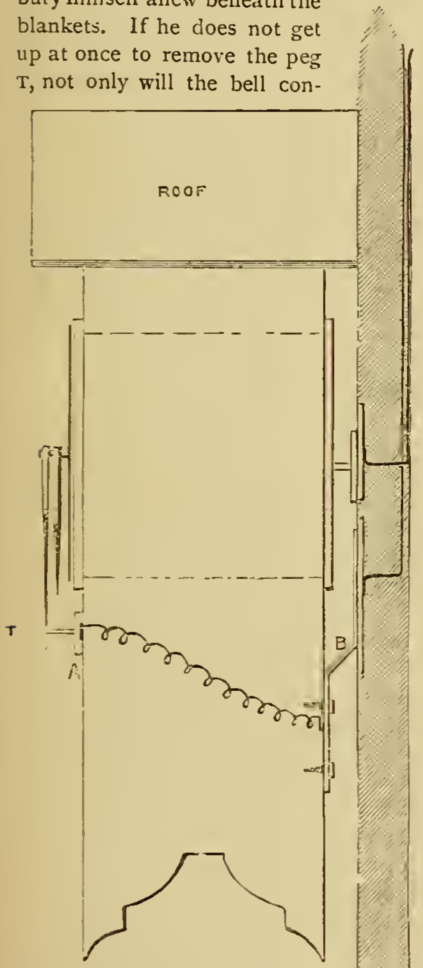


FIG. 3.—SIDE VIEW OF CLOCK.

tinue to ring, but the clock will be stopped, the long hand being checked in its course.

If anyone did not wish to get up—but this course I cannot recommend; it is pernicious, teaching as it does confirmed habits of idleness—an interrupter could be employed, or a thin slip of brass, or a fine platinum or brass wire, so extremely flexible as not to stop the works of the alarum, while allowing the bell to sound during a period of time which would depend on the length and flexibility of the slip or wire in question. Those who would like to apply this system of alarum-making to any ordinary clock or timepiece, can easily do so by insulating the existing dial-plate, or, still better, by substituting another of wood or

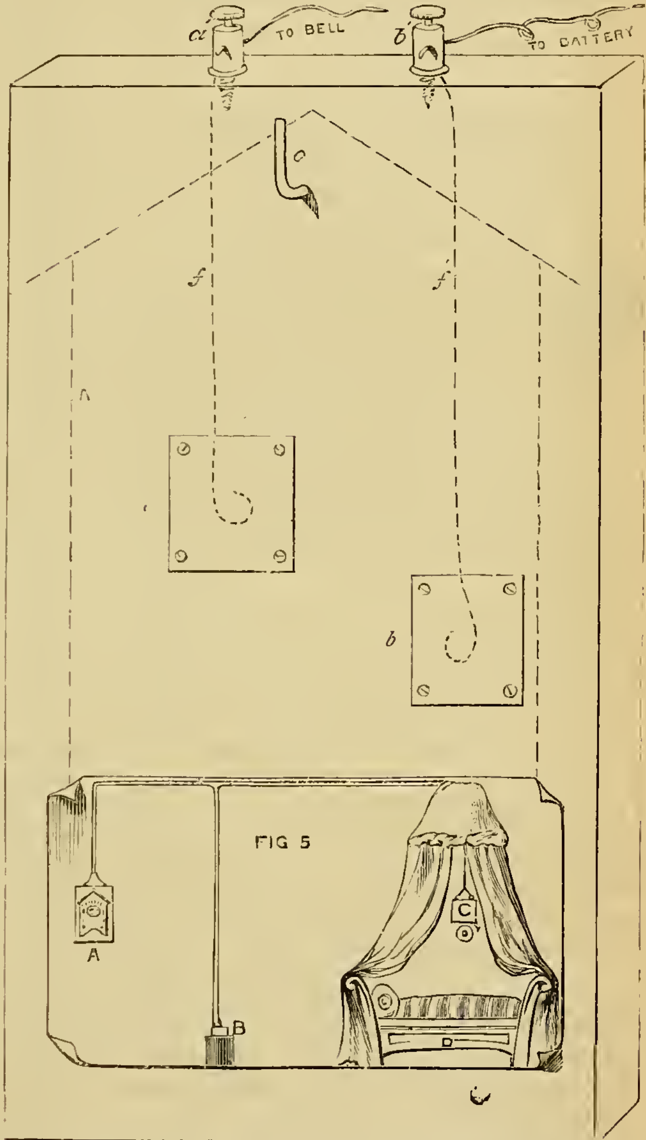


FIG. 4.—DIAGRAM SHOWING BACKBOARD AND CONNECTIONS WITH BELL AND BATTERY. FIG. 5.—SKETCH SHOWING POSITION OF CLOCK (A), BATTERY (B), BELL (C), AND BED (D).

ivory, and fixing to this, between the centre and the figures, the piece A, boring in it small holes which are to play the same part as those of A in the previous description.

If anyone desired to awake at any hour of the

night, no matter what, he must make the piece A of a circular form, and pierce it with thirty-six holes, three between each figure, in order to be roused at the quarters, half-hours, and hours.

It is now several months since I first began to use my electric alarum, and I can assure my readers that it has never failed to fulfil the injunction which may be read around its face.

THE REFLECTING TELESCOPE: ITS CONSTRUCTION AND MANUFACTURE.

By EDWARD A. FRANCIS.

VII.—THE POLISHER FOR THE SPECULUM.

IN the summer of the year 1782, William Herschel visited the metropolis, his fame as a telescope maker having preceded him to the Court. That the brilliancy of the new society into which he was suddenly plunged offered to our astronomer-optician no peculiar attraction, will from the following extract, be evident :—" I pass my time agreeably enough," he wrote to his sister on the 3rd of June, " but am rather at a loss for work I like. Company is not always pleasing, and I would much rather be polishing a speculum."

This expression shall be the motto of our seventh and subsequent chapters, wherein the reader may learn whether he will be at all likely in the future, in a moment of cynical humour, to make a similar statement; for the grinding, the trueing, and the fining have each been accomplished in turn, and the consummation of our speculum working is approaching.

It will be remembered that the concave glass surface should now present an " exquisitely fine, semi-transparent " appearance, the result of the minute scratches made during the last grinding with the sixty-minute emery. The polishing, which is but a still finer scratching process, must be performed with the aid of a more delicate abrading material. That material, which has been referred to in a previous paper, is rouge. Against the rivalry of oxide of tin (putty powder) and other substances, rouge has maintained, and appears likely to maintain, a premier position as a polishing medium for specula. The style of working, too, must be changed. It has hitherto been performed upon a rigid tool-surface ; it is now necessary that a softer surface should be employed, one into which the microscopic grains of the polishing powder may imbed. Cloth and paper serve this purpose efficiently when the optician is lense polishing : but for specula, pitch has been and is almost invariably used : which fact was before cited as a sample of the conservativeism of the art of speculum working, pitch being the substance selected by the very earliest of the makers of reflecting telescopes. The pitch has not been selected for this purpose only because it presents a surface in which the rouge grains may become imbedded — many other substances satisfying that requirement—but also because of its peculiar inelastic pliability.

In the first chapter it was shown that the curve which it would be absolutely necessary to communicate to the great speculum of a perfect Newtonian telescope was a parabolic one. Wanting this curve, the light from the object would be irregularly reflected, and the telescope would fail in its intended purpose for lack of defining power. While ever the grinding is continued with rigid tools, as for example, those of glass or iron, only a spherical concavity can be obtained : the pitch, on the contrary, by reason of its pliable inelasticity, will assume under skilful hands any peculiar curve, and, moreover, maintain that curve for a time sufficient to communicate it to the surface of the speculum.

This may be better comprehended, if the infinitesimal difference between the spherical and the parabolic concave, between the perfect and almost perfect mirror, is constantly kept before one. The amount of glass removed by a few dozen strokes with a pitch polishing tool would be, it may be thought, totally inappreciable, yet would it make a perceptible difference in the figure of a perfectly polished speculum.

Attempts have been made to substitute other, and apparently more suitable substances, for pitch, but only in rare cases has the ultimate success equalled that obtained with the old-fashioned polisher. From this summary may, perhaps, be excepted resin ; which possesses in its transparency a certain advantage over its opaque relation, but it appears to lack somewhat that peculiar pliability which is inseparable from good black pitch. Lord Rosse, when he required for his polisher a surface harder than a pitch surface, satisfied the requisition by the construction of a polisher having, as it were, a double skin. The base, or first coating, was composed of a comparatively soft resin, and the surface of a harder quality, toughened by the addition of wheaten flour. This addition was necessary to prevent small pieces of the resin from becoming detached from the somewhat brittle facets, and rolling about between the polisher and the speculum, and interfering seriously with the proper action of the polisher.

So that if the reader finds it impossible to obtain pitch of a suitable nature, a moderately soft resin will serve the requisite purpose.

In shape the polisher has been subjected under different hands to many variations, a description of which, and any discussion as to their effect on the

figure of the speculum, will appear more legitimately in the chapter on figuring. Here, only, shall be described the construction of a pitch polisher of that form which was adopted by the writer as the best, after a series of experiments with a variety of forms. Having as its base the glass tool, it is necessarily circular, and of the same diameter as the speculum. The pitch of which it is composed is known commercially as "best black pitch"; and is substantially the same as that used by the professional speculum workers in England and America. It is enclosed in small wooden boxes containing 1 lb. each, and costing in London at the oil and colour stores twopence.

It must be absolutely free from dirt or grit, and it generally is so: in order, however, to be assured of the fact, it is advisable to strain it, when melted, through muslin. A convenient, and at the same time safe, method of doing this is to break the pitch into small pieces, and place it in an earthen jar in an oven, until it is completely fluid, when it may be strained through distended muslin into a second receptacle, which in turn should be consigned to the oven when required.

While the pitch is being melted it is essential that it should be protected from dust and dirt, and also—and this is of the first importance—that it should not be allowed under any circumstances to boil. The action of boiling would generate air bubbles which it would be almost impossible to remove, and which, unless removed, would spoil the polisher; any variation of the temperature of the polishing room affecting the enclosed air and causing an elevation or depression, as the case might be, on the surface of the polisher. The pitch may be occasionally gently stirred while melting to increase its homogeneity; indeed it *must* be stirred, if resin, wax, or spirit of turpentine (for the purpose respectively of hardening, toughening or softening) be added to it.

It will be noticed from Fig. 2, that the pitch is attached in small squares or facets, each facet being separated from its fellow by a narrow channel. This formation is necessary for several reasons. The virtue of the polisher lies in its pliability, and this pliability is increased if each separate facet has space on every side to expand under the pressure of the speculum. If the pitch is of a proper consistency, very little expansion should occur; indeed, a serious diminution of the width of the channels is an evidence that the pitch of which the polisher has been composed is too soft for its purpose, and a new polisher of similar pitch with the addition of a certain quantity of resin would be required to be made. Again, it is necessary to the perfection of the polishing that the polishing material should be evenly moistened and distributed, and for this reason the channels have a complete intercommunication, so that the liquid which, as it were stores and moistens the rouge, may be regularly distributed. Furthermore, were these channels absent, the atmospheric pressure would offer a serious obstacle to ease of polishing, for the air being unable to reach the under side of the speculum would cause it to adhere to the pitch, with the result that the polisher would be spoiled.

The proper hardness of the pitch must be made a matter of experiment, many effects preventing the definition of any arbitrary test, but it should yield when cold to a moderate pressure of the thumb-nail.

To proceed with the construction of the polisher. Every appurtenance of the grinding, and every trace of emery should be removed from the bench, together with the glass tool. The latter, after washing and drying should be placed upon a level table or upon the bench, and should have fastened around its edge a strip of stout paper forming a rim about ¼ inch in height, to prevent the melted pitch from escaping. The paper need not be cemented to the edge of the glass, but only gummed slightly where it overlaps, this permits it to be easily removed. The precaution of providing this paper rim, may, it will be found, be dispensed with when a little experience in the construction of pitch polishers has been gained, for the workman then learns to distinguish when the pitch is of a proper consistency for pouring, and has poured the necessary quantity, rapidly moulded it to shape and stamped the facets, without permitting it to run down over the sides of the tool.

The sponge which has been used during the grinding processes must be placed aside, and a new one obtained, for even an elaborate cleansing may fail to remove some lurking grit from its recesses.

A portion of the rouge should be placed in a covered phial or wide-necked bottle, and water added to make a thick solution. To apply the rouge a camel's-hair brush, preferably flat and about ½ inch across, may be used. It is imperative that this rouge-pot should be covered when not in use, to exclude grit from it. The speculum, together with a dish of clean lukewarm water in which it can be partially immersed in a case of emergency, should be at hand.

The tool should be now gently warmed, and the surface kept perfectly dry; the inside of the paper rim only being wetted to prevent its adhesion to the pitch. The pitch should be poured gently on from the centre, until the convex glass surface is covered to the depth of a little less than a ¼ inch. If the pitch be not of sufficient liquidity to spread rapidly to the paper rim, it may be poured on by a spiral motion from the centre to the edge. As soon as a sufficient quantity is poured, the speculum previously wetted with the rouge brush on every part of its concave sur-

face, should be laid centrally on the pitched tool and quickly removed; this moulding to be repeated until the pitch has assumed a convex surface of the same spherical curve as that of the speculum. The paper rim may now be torn away, and the superfluous pitch at the edges may be cut off, the speculum centrally placed on the tool forming a guide for the knife. Each time the speculum is used for moulding, it should be wetted, to prevent adhesion to the pitch, and for the same reason the time that it is allowed to remain in position should be very short.

The pitch, as stated, should be poured on to the thickness of about a $\frac{1}{4}$ inch, rather less than more. The thickness of the pitch coating is a somewhat important point. Primarily, it must be of uniform thickness, for if, for example, the tool were so tilted that the thickness of the pitch at one side was much greater than that at the other, and the after moulding with the speculum failed to correct the error, the thicker parts of the polisher would be more pliable than the thinner, the polish would be irregular, and the figure of the speculum would be spoiled. The liability of any appreciable error from such a cause, evidently decreases with the thickness of the pitch. On the other hand, unless the pitchy coating is of a certain thickness, the pliability which is the special virtue of the pitch would be comparatively lost. For a speculum of the size with which we are dealing, a thickness of $\frac{1}{4}$ inch has been proved by experience to be very suitable; and although it is less than is generally advocated, the reader is advised at the beginning to have his polisher, with respect to this standard, slightly thinner rather than thicker. If a reflector of larger dimensions were being figured, it is advisable to increase the thickness in proportion.

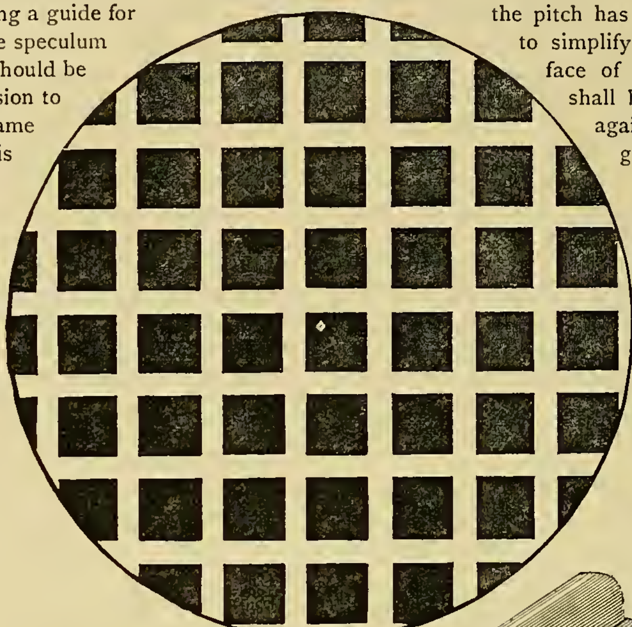


FIG. 35.
THE POLISHER OF PITCH.
Scale, half size, or 6 in. to 1 ft.

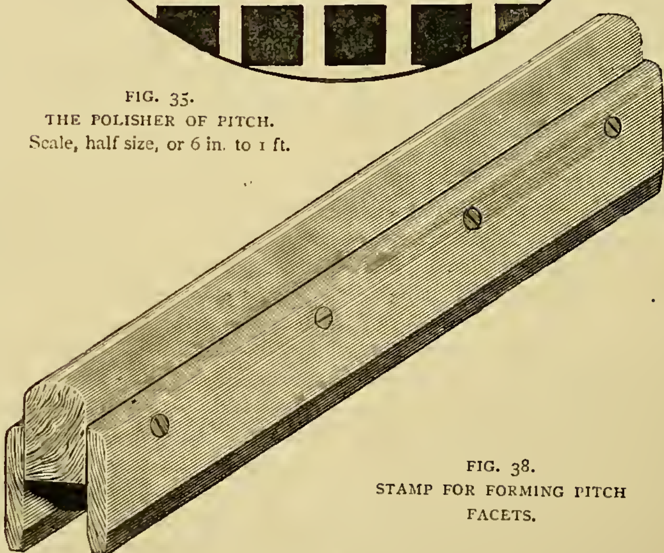


FIG. 38.
STAMP FOR FORMING PITCH FACETS.

We have now a pitch tool, correctly formed, but not faceted. As a matter of fact, faceting, when produced by stamping, can be accomplished before the pitch has thoroughly cooled; but, to simplify matters, the pitch surface of this, the first polisher, shall be warmed and softened again, in order to allow the grooves to be formed. From Fig. 35 the arrangement of the facets can be seen; and Fig. 36, which is a sketch of a portion of a typical pitch polisher, shows the facet in relief. It is plainly evident from the latter sketch, that if each facet could be separately cemented to the convex tool, the pouring and spreading of the pitch which has just been described might be dispensed with. This is sometimes done, the facets being cast from molten pitch, in little moulds, and afterwards attached to the curved surface of the tool, upon which the places they were to occupy had been previously marked. Or the pitch is rolled into a strip of uniform thickness, and the facets cut from the strip.

The first process is one to be recommended, but it entails considerable labour; practically, neither is advisable when the surface to be covered is so small as that with which we have to deal. Moreover, we have the pitch, before use, in a solid sheet, and we have only two other methods left to select from: these are cutting and stamping. In the former, the facets being carefully marked out, the grooves are either sawn out with a very fine saw, or cut with a sharp chisel, with

the accompaniments of chips of pitch, and the risk of damaging the facets: therefore it cannot be recommended. With the stamping there are no chips whatever, and no danger of damaging the polishing surface.

The method of stamping will be evident from a short study of Fig. 37: the actual instrument used is shown in Fig. 38. We will term it the stamper. It consists of two small slips of wood each 7 inches long, $1\frac{1}{4}$ inches wide, and about $\frac{1}{4}$ inch thick: the harder the wood the better. A third slip of wood, of the same length, but of a width equal to that decided upon for the facets, is placed between the former two, and the three pieces are firmly screwed together, as indicated in section in Fig. 37. The upper edges of all three are rounded or finished in some other manner; but the lower edge of the central piece is left square, and those of the others slightly bevelled, in order that the base of the facet shall be wider than the top. The edges should also be curved in a manner similar to the concave gauge.

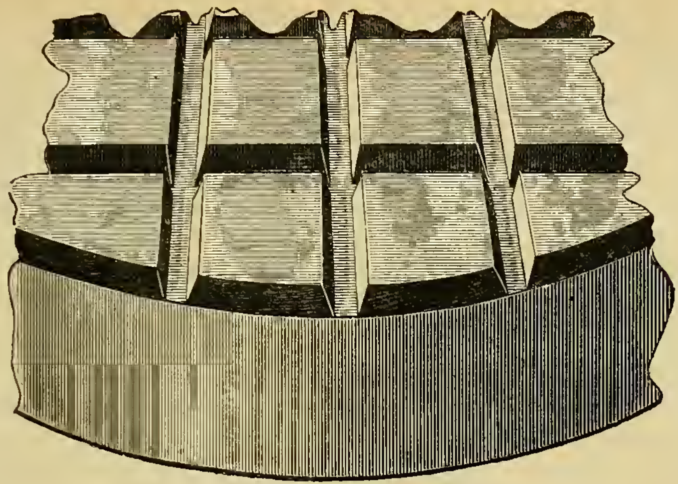


FIG. 36.—PORTION OF PITCH POLISHER SHOWING FACETS IN RELIEF.

It has been stated that the stamping of the polisher should be performed between the moment of pouring out the filtered pitch and its cooling, but that, as the making of the polisher is a very important part of the speculum worker's business, the pitch may be softened again, in order that the stamping may be a complete success. To effect this, the polisher may be simply held before a fire; but it is likely to soften irregularly. It is best to have recourse to an oven, which being but moderately heated, should soften the pitch equally throughout. One other thing may be considered before the stamping begins. The figure which the concave has, is, we hope, truly spherical: to preserve that figure in all its regularity must be our endeavour in the polishing; for if once we lose control over its regularity, we may very possibly have to regrind the glass to regain the lost curve. For the curve to remain unaltered while the glass is being cut away, it is plainly necessary that the surface must be equally abraded or polished—a point of perfection much easier to conceive than to reach; and the arrangement of the facets has a great deal to do with its ultimate attainment. If one facet were placed exactly in the centre of the glass tool, and the others were geometrically arranged round it, perfection, as far as appearances go, would be reached; but a slight investigation would lay bare the fact that the tool would then consist of rings of pitch concentric with the tool. The application of a pair of dividers to Fig. 35 will at once indicate what is meant. The dividers should be centred on the central point of the central facet (which, be it noted, is *not* the white point); and then if a series of circles be drawn, certain of them will be seen to be entirely on the black facets, and others almost entirely on the white channels. So that the surface of the speculum, if centrally worked, would be irregularly worked, rings of unequal wear forming.

The same test applied with the dividers centred on the white spot, which is really the centre of the polisher, will demonstrate by the aid of a little research that the arrangement of facets given in Fig. 35 is almost perfect; as a matter of fact, it even allows side motion to be dispensed with occasionally in the figuring. For, be it remembered, side stroke is only introduced to neutralize errors (such as those rings of unequal wear) which are caused by the constant coincidence of the centres of the tool and speculum, and here

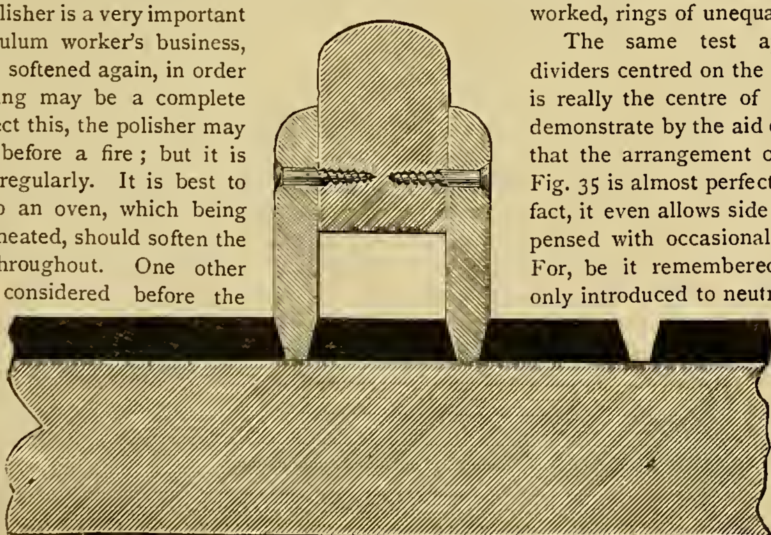


FIG. 37.—STAMP FOR TURNING PITCH FACETS, IN SECTION.

when the discs of tool and speculum coincide the actual working centres do not.

The size of the facets is another point which must be considered. Those shown in Fig. 35 are one-half of the most suitable size, unless the squares are to be again subdivided by smaller channels.

To return again to the stamping. The pitch having been heated to a proper pliability, the stamper which should have been well soaked in water, should be smeared on its lower edges with the rouge-brush, and the centre of the blank pitch tool and the position of the central groove being marked, the little instrument should be placed in position, and firmly pressed down, forming two grooves, which we will call *a* and *b*, that nearest the centre of the tool being *a*. The stamper being then moved until that lower edge which formed groove *a* is in groove *b*, pressure should be again supplied, resulting in the formation of another groove. This action should be repeated until the pitch has cooled, by which time the polisher will have probably received the impression of one set of parallel grooves. A second series, at right angles to the first must then be stamped in a similar manner. The polisher will then present the appearance of Fig. 35, but the grooves will require to be perfected. To do this, place the speculum in a vessel partly filled with lukewarm water, and slowly raise the temperature by the addition of hotter water until the speculum is moderately heated. The heat should be very slowly raised or the glass may break. The surface of the speculum being smeared with rouge and water, it must then be placed over the pitch facets, to bring the surface of the polisher into exact conformity with the concave glass. The pitch tool may also with advantage be suspended for a few moments in warm water, and then the heated speculum prevents the pitch from quickly setting while the weight of the heavy disc of glass shapes the surface. The speculum must not be allowed to dry, or remain long in one fixed position during the short time that it is on the polisher. When this has been done the channels will, in all probability, have slightly closed, and an elevation will be observed at the edge of each facet, where the thickness of the pitch has increased as a necessary consequence of the formation of the grooves. The softening, stamping, and moulding must be continued until the two effects above-mentioned are no longer noticeable, the grooves presenting a clean and regular appearance. It is essential that they should intercommunicate freely. The facets may, finally, if extreme precision be desired, be trimmed off with a fine edged chisel or a razor.

Cover now the whole polisher with a single coating of rouge, and rest the previously-sponged speculum upon it for a moment. Each facet should leave an imprint in rouge upon the glass concave, otherwise the pitch is irregularly moulded and will require further attention. Lastly, the polisher may be rinsed in tepid water, and replaced in a rigid position upon the bench, and the speculum, being placed centrally upon it should be allowed to remain so, with the exception of slight movements to prevent adhesion, for fifteen or twenty minutes. At the end of that time the pitch and glass surfaces will be in complete contact, and the polisher making will be finished.

The glass is polished by moving it to and fro in a manner precisely similar to, but far more deliberate than, the grinding movement.

It was intended to completely dispose of the polishing, as distinguished from the figuring, in this chapter, but the inexorable fiat of space forbids the completion of that intention. Enough has been written, however, to initiate the reader into the manufacture of the polisher; that manufacture he may practise, although it is doubtful whether he will construct as many as did the writer for *his* first speculum, which, and herein rests a moral—slipped when completed off the polisher on to the stone floor of the workshop with disastrous results. Under no circumstances, when experimenting in the construction of polishers, leave the speculum unguarded.

Above all, do not attempt to actually polish until the next chapter has been read; for the unwise polishing of an hour will necessitate a return to the earlier processes.

(*To be continued.*)

GLASS PAINTING AND DECORATIVE GLAZING.

By L. L. STOKES.

V.—ENAMEL PAINTING ON GLASS.—PLAIN PATTERN GLAZING.

ENAMEL PAINTING ON GLASS.—In dealing with stained glass work, we have seen how in that branch of our art the effect as regards colour mainly depends upon the original stain of the material, and that applied colour, apart from the means employed for producing light and shadow, is merely an occasional and accessory thing. In that branch with which we have now to deal, we shall see that applied colours are everything, the glass used being of the ordinary colourless kind.

Since in enamelled work the designs are carried out on large and regularly-shaped sheets of glass, the designer is enabled to work with far greater freedom

than when engaged on stained work. He can give scope to his taste and fancy without being embarrassed by the necessity for arranging lead-lines, or by considerations as to whether this or that form can or cannot be cut with the diamond. He can consider his sheet of glass almost as if it were a sheet of paper.

He will begin his work almost in the same manner as that recommended for stained glass. It is well first to make a small coloured sketch, and from it to draw out a cartoon of full size. But whilst for stained work it is often a convenience to colour the cartoon, for enamelled work this should never be done, for if left in black and white only, it can be placed behind the sheet of glass to be painted, and the principal lines, shadows, etc., traced directly from it.

Upon the glass also the earlier operations are much the same as in stained work. It may be matted in the same manner. All the drawing of the design, with its lines, lights, and shadows, has to be worked out in tracing colour, and the glass has to receive a first firing, before the actual enamelling is begun. Fig. 22 shows a design suited to enamel painting, in the shaded stage, and ready for its first visit to the kiln.

After the burning in of the tracing colours, and the subsequent cleaning of the glass, it will be ready for enamelling. The colours to be used are prepared from mineral pigments, vitrified into a soft glass, and then reduced to powder. For use, these colours have to be nicely ground up, like the tracing colour, with weak gum water. Some, however, prefer to use fat oil and turpentine as a medium instead of gum. The question is rather one for individual taste and practice. The colours thus prepared are laid on the surface, and worked flat and even with the broad, flat brush, somewhat in the same manner as the mat is flattened. All the lights and shadows of the design were, as we have seen, previously laid in with tracing colour, so that the enamel colour has to be applied as flat washes merely. The enamel having thus been laid on every part, the work is allowed to dry, and is then brushed lightly over with tar spirit. This fixes the colours in a temporary manner; and after it has dried, a second coating of enamel can be added to such parts as may seem to require greater depth of colour; but it must this time be ground with tar spirit instead of gum. The subject before us will be for an autumnal effect with brown, green, and yellow tints. After enamelling, firing has again to be resorted to, and possibly more than once; for retouching and strengthening are even more called for in this than in stained glass work.

If the operator tries enamel painting after working in stained glass, he will probably feel some disappointment at the weak effect produced by the colours when fired; but he will not do wisely if he attempts to make up for this shortcoming by laying them on more thickly. Too thick a wash will probably blister in the kiln, and produce a failure. His best way by which to attain a proper depth of colour will be by successive washes, followed by successive firings.

The depth and brilliancy of stained glass he must never hope to succeed in reaching. Nothing approaching the intense lustre of ruby pot-metal is to be looked for in this kind of work. The red which approaches it most nearly is attained by using a purple-pink enamel on the front, in conjunction with gold stain on the back of the glass. Gold stain, it is to be noted, can be used with the same facility in this as in stained work. Indeed, it is a necessary expedient when a good green is required. Enamel colours furnish no satisfactory green, and blue on the face with gold stain on the back of the glass must be used as a substitute for it. There is a white among the enamel colours, and in grinding and mixing the operator should be warned not to touch it with his steel palette knife. To preserve its delicacy use an ivory one.

Backgrounds and borders may be enriched in enamel work with much facility. The former may be divided into diapers, or treated as what heralds would call "semée"—strewn over, that is, with flowers, etc., placed at equal distances—without the trouble of drawing these things upon the cartoon. To do this a piece of cartridge paper is ruled in quarries, as in Fig. 23, and placed upon the easel, behind the glass. It will readily be seen that with these lines as a guide, a diaper pattern may be easily put in with the brush and tracing colour alone; or, say, fleur-de-lis drawn with regularity at each intersection of the lines. Borders may be worked by an equally simple arrangement of a like nature.

To lay down positive rules for the proportioning and arrangement of colour, whether in enamel or in the other kinds of glass work, would be idle and unsatisfactory. Tastes vary widely, and this question is one which must be left to the private judgment of the worker. The production of really good colour in glass, as in painting, can only result from a special and instinctive talent, which is a natural gift and not to be taught. A few hints may, however, help the beginner to avoid glaring bad taste. In a general way it may be said that grisaille—that is, white glass, with tracing colour decorations—or in plain pattern work a neutral tint, may be used most freely; next will come yellow or gold stain; red, blue, green, and orange are to be used more sparingly; and purple most sparingly of all. Whenever light or grey can be introduced between positive colours in arranging a design, it will usually be found that the effect is enhanced by so doing. In designing it is also desirable to consider the aspect in which the work is to be placed. If the window is to look towards the south, stronger colours

will be needed than if it were to look towards the north; for lines which otherwise appear deep and rich will seem comparatively weak and poor in the sunshine. A "patchy" effect is also a thing to be guarded against from too sudden approaches of strong and light colours.

Plain Pattern Glazing. — In old houses of the Elizabethan period, it is not unusual to meet with windows in which the lead lines are so arranged in a geometrical design as to cut up the whole of the glass into small but regularly shaped pieces; somewhat in the manner shown in Fig. 24. Sometimes, when as is frequent in this style, the window is divided by stone mullions and transoms, the small, square upper lights have heraldic shields, in coloured glass, as centres. Such windows had, and have when perfect, much artistic beauty, but after the

FIG. 22.—SUBJECT FOR ENAMEL PAINTING, SHADED AND READY FOR FIRST FIRING.

FIG 24.

FIG. 25.

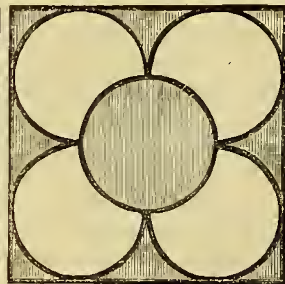


FIG. 26.

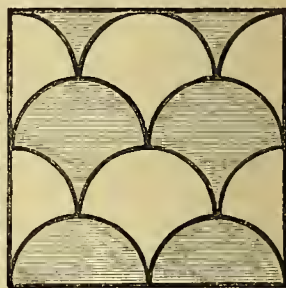


FIG. 27.

FIGS. 24, 25, 26, 27.—EXAMPLES IN PLAIN PATTERN GLAZING.

*** Fig. 24 is in White Glass; Figs. 25, 26, 27, are in Two Tints.

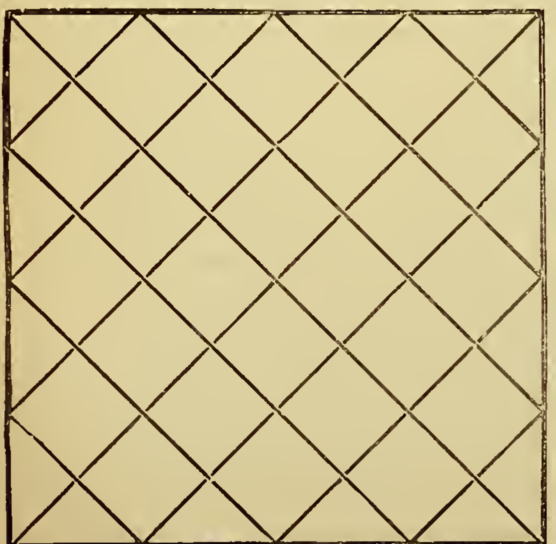


FIG. 23.—ENAMEL PAINTING; METHOD OF WORKING DIAPERS.

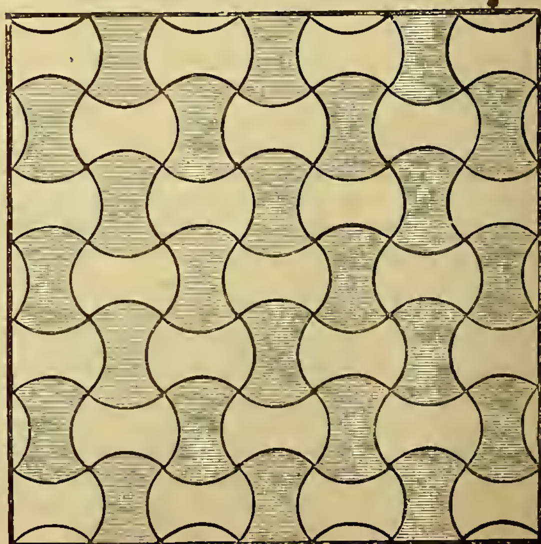


FIG. 28.—PLAIN PATTERN GLAZING IN TWO TINTS.

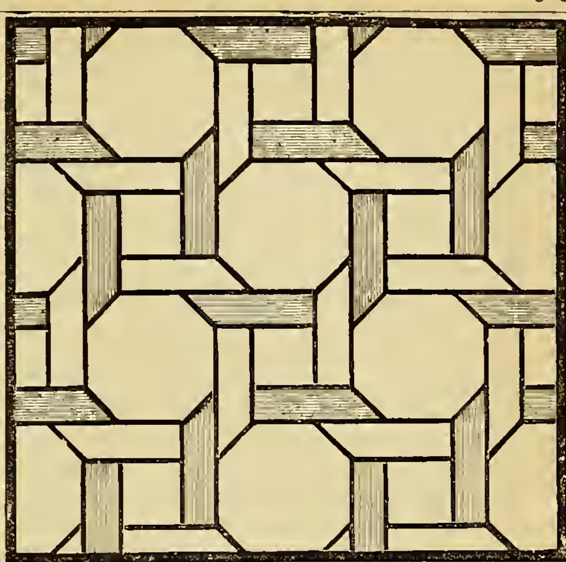


FIG. 29.—PLAIN PATTERN GLAZING INTERLACING PATTERN FOR THREE OR MORE TINTS.

above-mentioned period the art of making them—plain pattern glazing, as it has been called—fell wholly into disuse.

In our own times, however, plain pattern glazing has been much revived, but with this difference, that whereas in the old work, white, or what was then the nearest approach to white, glass alone was used, the modern worker combines various colours and shades. By this latter method excellent effects are produced, as well for windows as for screens and other internal work.

Plain pattern glazing may be and often is used in combination with painting, as is exemplified in Fig. 31, yet such a combination is by no means necessary. It is capable of producing admirable effects when used alone, and in that case it may form the employment of those who possess no power of drawing or artistic knowledge. Nor does it demand any great amount of even mechanical skill, for the forms in plain pattern glazing are generally regular and easily cut; whilst for carrying out it needs few appliances beyond the diamond and the soldering bit. Indeed, it would seem to be a question whether the last tool may not shortly be dispensed with; for in this place may be mentioned a recent invention, which, if brought into use, promises to reduce the labour of the plain pattern glazer to a minimum. A Madame Delong, an ingenious French lady, has, among other uses to which she has applied sheet metal pierced by her patent process, invented a new system of glazing. In this she dispenses with the use of leads, and claims to have introduced a substitute far superior to them. It may be questioned whether in stained glass work her plan will ever supersede the old one; but for plain pattern glazing it appears to have advantages which at least render it deserving the consideration of amateur workers; and especially of those who have not accustomed themselves to the process of soldering. The pierced metal work closes on the glass with minute screws. No skill is required to put the window together, and, what is certainly a strong point in favour of the new plan, the framework can be unscrewed and taken to pieces again at pleasure. That lead work is both weak and clumsy must frankly be admitted, so that the advantages

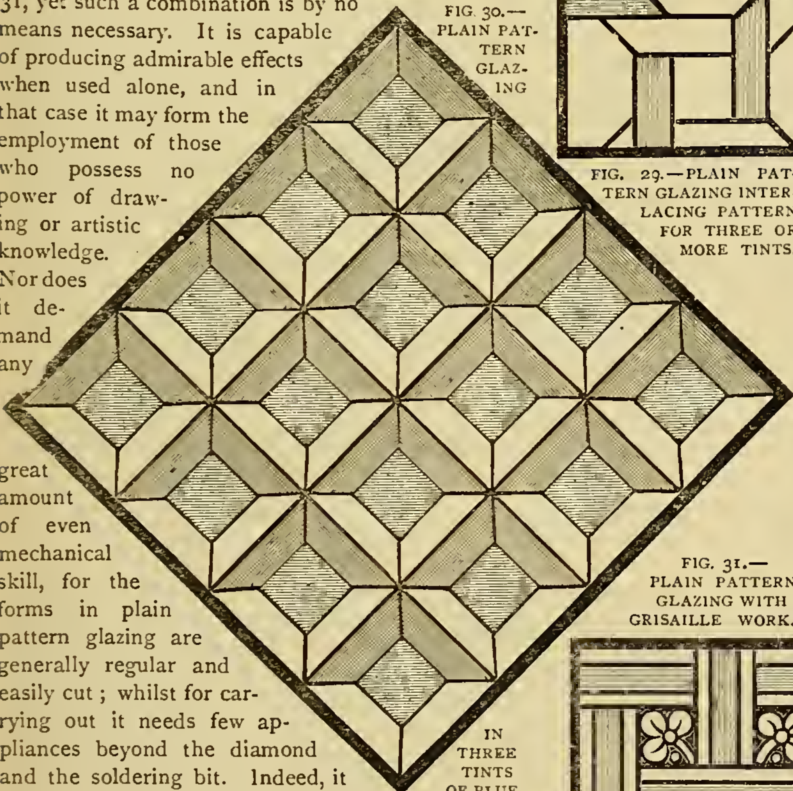


FIG. 30.—PLAIN PATTERN GLAZING IN THREE TINTS OF BLUE.

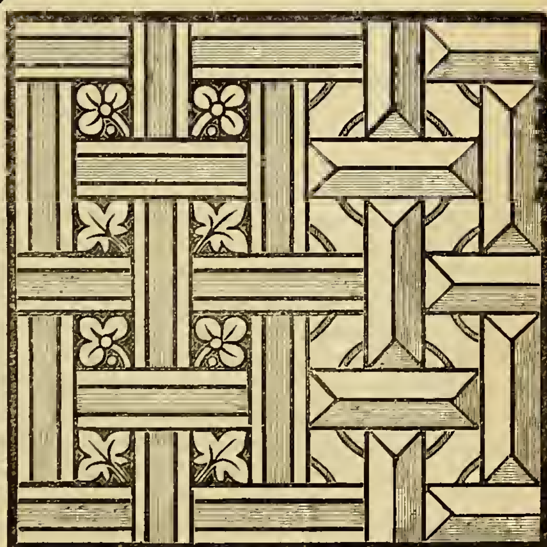


FIG. 31.—PLAIN PATTERN GLAZING WITH GRISAILLE WORK.

of Madame Delong's system in strength and neatness will be obvious; moreover, the inventor claims that it is one third cheaper than the old system. All, it is presumed, that the worker would have to do would be to send his lead-line cartoon to the patentees, and have it pierced in metal. Examples are to be seen and information obtained at H. Delong and Co.'s, 20, *Regent Street, London, S.W.*

There are certain minor uses to which decorative glazing may be applied, for which Madame Delong's system would seem especially to recommend itself. These uses being exclusively modern need not come under the influence of that conservative sentiment which clings to the mediæval and orthodox method of joining glass wherever stained windows are concerned. In these, the leads, unsightly in themselves, and positively ugly where the soldered joints occur, are close to and always beneath the eye; and in these, moreover, since the introduction of supporting iron bars would be highly objectionable, a substantial and rigid framework is a desideratum. These are when ornamental glass is used *within* the house.

In artistic modern dwellings we not unfrequently see such glass employed with good effect in screens, also in partitions and in the panels of doors, through which it is desired that an amount of lightshould be transmitted. In the last case there is an especial demand for a strong framework which shall bear repeated jarrings without injury, which mere lead cannot do. Another use of the same class is for dwarf blinds for street windows. Here too the work will often be subjected to touch and pressure, and will be better for a framework which will neither bend nor become loosened.

For those purposes, at least, the new plan may be worth a trial; and it is probable that in many instances, the amateur glass-worker will prefer to apply his first attempt to some one of these minor purposes before he ventures on a window.

If door panels are to be filled, it is tolerably certain that coloured glass will, to a greater or less extent, be chosen, for in such situation it would be next to impossible to get a satisfactory effect without colour. But in a partition, and still more in a dwarf blind, where light will be abundant, good results may be attained by using cathedral glass only. Its uneven surface will secure as much obscurity as is necessary, and variety can be gained by taking two or more tints. A central medallion in grisaille, kept low in tone, and the remaining portion filled with cathedral glass arranged in a good geometrical pattern, makes a tasteful and pleasing blind; and forms no bad subject for an early effort in this branch of the art. But this by-the-by.

If the reader will refer to the illustrations of plain pattern work, he will see that Fig. 24 is intended to be carried out in white only. Figs. 25, 26, 27, and 28 are for two tints—white in combination with glass of a low greenish or yellowish hue. Fig. 29 is shown as of two tints only, and may be so worked; but it is a pattern which may be much varied in carrying out. A bright window might be formed in which blue bands should interlace with red, the squares and octagons being left white, or the effect would be richer and more subdued if the two latter forms were painted in grisaille—the first being each filled with a small diaper flower, the last treated as medallions.

Of the design given in Fig. 30, a fine example may be seen in South Kensington Museum. The pieces of glass are small, the colours are five tints of blue, and the effect produced is very rich and beautiful. Fig. 31 shows two variations in a design which is to be worked out by a combination of plain pattern glazing and grisaille painting. The interlacing bands in this might be of two colours, say red and blue, or green and orange.

Something more on plain pattern glazing remains to be said in a future article—the concluding one of this series.

(*To be continued.*)

HOW I FURNISHED MY HALL.

By MARK MALLETT.

III.—MY BRACKET SHELVES.

THE remaining piece of furniture made for my hall was that shown in elevation in Fig. 16. I have called it "My Bracket Shelves," but it will be observed that beside shelves it comprises a couple of lockers. It was important that it should not be an obstruction, so I made its greatest projections $7\frac{1}{2}$ inches only, as will be seen in the section, Fig. 17.

As I intended this little article to be easy of removal, I so made it as to hang by the three upright strips marked A, A, A, in Fig. 16, and upon these pieces I constructed the whole affair. To cut these upright strips was my first business. The shapes of their upper and lower ends are seen in Fig. 16; their middle parts, which pass behind the shelves, and are unseen, are quite straight, so that there can be no occasion for figuring them upon a larger scale. They are of $\frac{1}{2}$ inch wood, $3\frac{1}{2}$ inches wide, the length of the centre strip is $3\frac{1}{2}$ feet, that of the two others 3 feet.

To fit across these at right angles I required three shelves. I made them of $\frac{3}{4}$ inch wood. Of these the

two lower were alike, and a portion of one of these is shown in Figs. 18 and 19. These two shelves are $7\frac{1}{2}$ inches wide, and, including what is required for shaping the ornamental ends, 3 feet long. The dotted lines in Fig. 18 show where the arrangements for the lockers rest upon the shelf. This is supposed to be the upper side of the lowest shelf, but it will be seen that it might equally serve to represent the lower side of the middle shelf, as the two are precisely similar. At A, A, in this figure are shown openings cut in the back edge of the shelf to admit the upright strips.

I first fitted the bottom shelf, and fixed it by driving flat-headed screws through the upright strips into its back. I then cut the three upright boards which form the ends of the two lockers and the division between them. These were $\frac{3}{4}$ inch thick, 8 inches high, and 6 inches wide. They were plain straightforward pieces and require no separate drawing. The dotted lines at B, B, Fig. 18, show where their bottoms were placed on the lower shelf. I fixed them with flat-headed screws through the shelf from below, and through the upright strips from behind.

Upon the tops of these upright boards I placed my middle shelf—the counter part of that below, and fixed that also in place by screws through the upright strips into its back, and by others driven through it downwards into the tops of the upright boards.

I next fitted in the backs of my lockers. They were of $\frac{1}{4}$ inch wood, 18 inches by 13 inches, and I screwed them with $\frac{1}{2}$ inch flat-headed screws into the upright strips. The dotted lines at C, Fig. 18, indicate the position of one of these backs.

The hinge-pieces which support the lids of the lockers, and the central piece against which those lids shut (shown in section respectively at D and E, Fig. 18) were next added. These were of inch wood 8 inches long. The hinge pieces, D, Fig. 18, are quite plain, and $1\frac{1}{2}$ inches wide, but the central piece, E, which is 3 inches wide, has a rebate down each side $\frac{3}{4}$ inch deep and $\frac{1}{4}$ inch wide. These three pieces are fixed by flat-headed screws driven into their ends through the middle and bottom shelves, and also by round-headed screws, as shown in Fig. 16, driven through them into the edges of the upright boards.

Leaving the lids of the lockers to be added last of all, I next proceeded with the arcade which occupies the space between the top and middle shelves. A reference to the section, Fig. 17, will show that this arcade stands back one inch from the front edge of the middle shelf; thus the upright boards which divide and flank it are only 6 inches wide. They are of $\frac{3}{4}$ inch wood, $9\frac{1}{2}$ inches high, and three in number. In Fig. 19, which shows the upper side of the middle shelf, the dotted lines at F F indicate the positions of the bases of these boards. From the ame illustration G, Fig. 19, it will be seen that alternately with them are placed two pillars, $\frac{3}{4}$ inch square. Fig. 16 shows how the corners of these pillars, as also the front edges of the upright boards, are bevelled off so as to give more finish. Both the boards and the pillars are, when fixed in place, dowelled into the middle shelf and screwed to the upper one : the boards also, like those below, being screwed to the upright strips. A back of thin board is given to the arcade in the same way as to the lockers.

The upper shelf which rests on these pieces is of the same thickness as those below, but only 6 inches wide and $2\frac{1}{2}$ feet long. A part of it is given in Fig. 20. It will be seen that the back of this shelf is merely set against the upright strips, instead of having openings cut to receive them like those below ; also, that its ends extend no further than the outer edges of the outside strips. The dotted line along its front at H marks the position of the board which forms the arches of the arcade.

For this I considered a strip of $\frac{1}{4}$ inch wood to be sufficient. It was 2 feet 4 inches long and $3\frac{1}{2}$ inches wide. Fig. 16 shows how it is fastened with small round-headed screws to the upright boards and pillars, and to the edge of the upper shelf.

A strip of similar wood of the same length, but 4 inches wide, forms the ornamental back to the upper shelf. Its shape is sufficiently shown in Fig. 16. Both the scollops on the upper edge of this, and the segments of circles in the strip below, could I found, in such thin pine board, be more easily and safely cut with a keen knife than with a saw.

One of the pieces which form the backs of the corner-nooks at each end is shown in Fig. 21. These pieces are of $\frac{1}{2}$ inch wood like those upright strips against which they fit. The dotted lines show where they pass at the backs of the two lower shelves, which are cut away to receive them, as shown at I, Figs. 18 and 19, and they are there screwed from behind. A screw, as shown in Fig. 21, also fixes the top of each piece to the adjacent upright strip.

Fig. 16 shows that the bottom shelf has three supports. Of these that in the centre is shown in the section, Fig. 17 at K, whilst both the central and an outside one are seen on a larger scale at K and L in Fig. 22. These supports add both to strength and appearance. They are of 1 inch wood. The central one K, Fig. 22, is 5 inches high and projects 4 inches. The outside ones have the same projection, but are only 4 inches high. These are dowelled into the under side of the shelf, and screwed from behind to the upright strips.

The doors of the lockers were the parts last made I cut them to fit the spaces from $\frac{1}{4}$ inch stuff, and then proceeded to give them the effect of decorative

panels, by screwing 2 inch strips of the same around them, with small round-headed screws, as seen in Fig. 16. I set these doors $\frac{1}{4}$ inch back from the general level of the fronts of shelves, hinge-pieces, etc., for the sake of effect.

For hanging up my shelves I drove three brass hooks firmly into the wall to match the three holes in the upper ends of my upright strips; and when I had hung the shelves on them, that I might keep my piece of furniture perfectly steady, I drove three brass-headed nails tightly through the three holes at bottom.

The illustrations to my Bracket Shelves are all on a 2-inch scale, except the elevation, Fig. 16, and the section, Fig. 17, which are 1 inch only to the foot.

This piece of furniture, when it was completed and put in place, looked uncommonly well on the wall, and, on account of its good appearance and obvious utility, became the object of much attention and close scrutiny on the part of my visitors. There were other things that I made for the ornamentation of my hall, it is true, but as these consisted for the most part of projecting over doors, and additions of this nature, whose construction has been ably described by another writer, I forbear to trouble my readers with them.

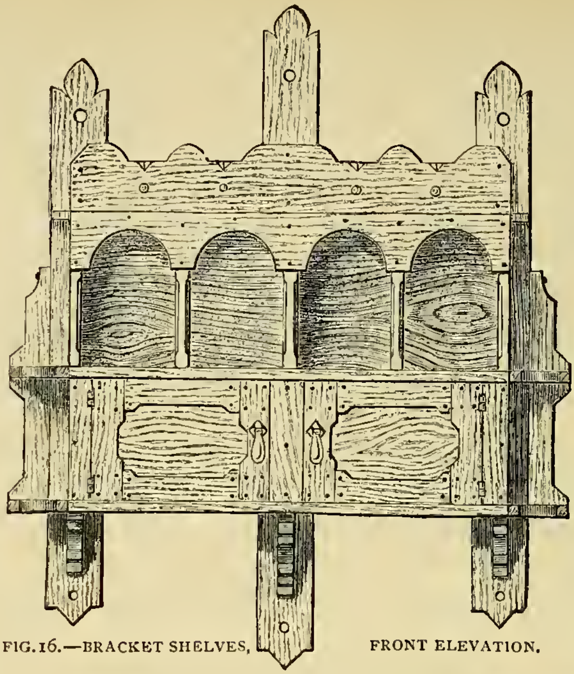


FIG. 16.—BRACKET SHELVES, FRONT ELEVATION.

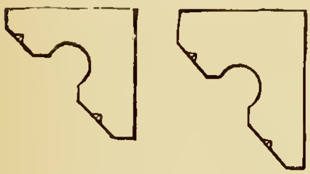


FIG. 22.—SUPPORTS FOR LOWER SHELVES.

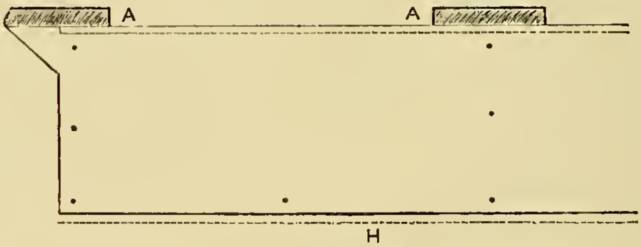


FIG. 20. TOP SHELF, UPPER SIDE.

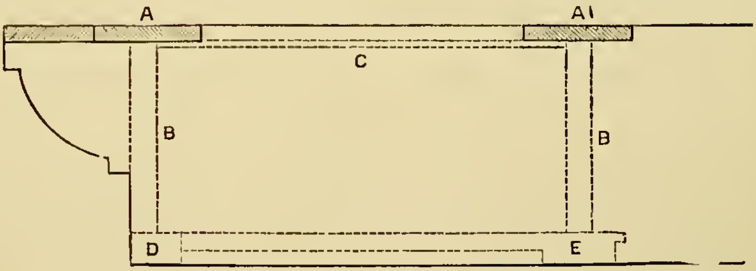


FIG. 18—BOTTOM SHELF, UPPER SIDE.

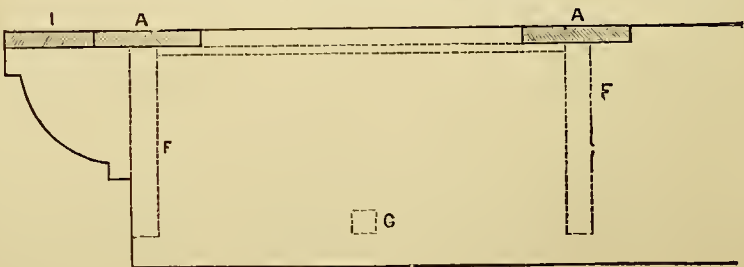


FIG. 19.—MIDDLE SHELF, UPPER SIDE.

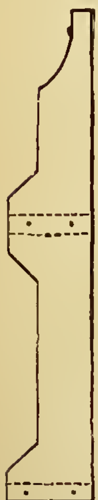


FIG. 21.—BACK OF CORNER NOOK.

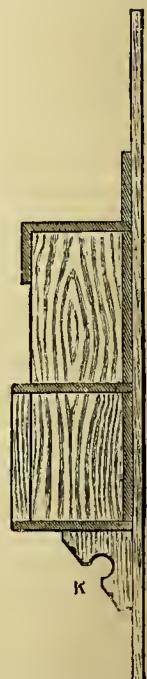


FIG. 17.—VERTICAL SECTION THROUGH CENTRE.

HOW TO MEND BROKEN CHINA, GLASS, ETC., WITH RIVETS OR CLASPS.

By WALTER SPENCER.

"ONLY *threepence a rivet*"—and a small sum of money to spend, it seems, for the restoration to usefulness of that misguided pot, which, "*Please, ma'am, it came all to pieces in my hand this morning.*" By a lucky chance, a periodical visitor of ours called to-day, the man who carries all his apparatus in one of the side pockets of his coat, and who offers to mend any china or glass at the small cost of only threepence a rivet.

We give him to mend the lid of a soup tureen (earthenware), a couple of dessert plates (china) in four pieces, and maybe, an old-fashioned celery glass whose stalk has come to grief. In about an hour and a quarter these four useful and familiar friends will come back to us repaired, with a modest request for the sum of *eight shillings* or so, rather more than the entire cost of all the tools necessary for the art of china mending with clasps or rivets—plus Part 54 of AMATEUR WORK, in which the writer of this short article hopes to give practical help to those victims of the "threepence a rivet" cry, who, like himself, have been induced to pay for mending them more than the broken articles were worth. Your peddler knows his way about too well to tell you before he begins his work *how many* rivets each broken article will need. You expect to see three (9d.) or four (1s.) at most, where you will probably find at least eight (2s.), and most likely your celery glass is mended with *silver* (?) rivets at sixpence or eightpence each, say four for half-a-crown; and thus the process of china mending, simple and easy as it is, becomes a very costly one in a very short space of time.

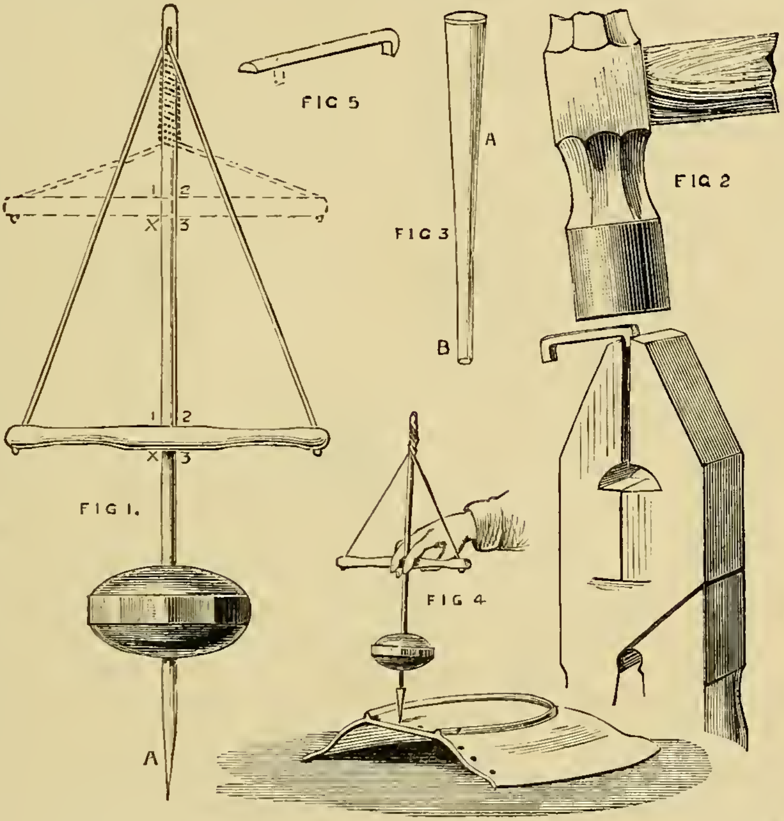


FIG. 1.—THE DRILL—A, Cone to receive Socket shown in Fig. 3. FIG. 2.—MODE OF FORMING RIVET WITH HAMMER AND PLIERS. FIG. 3.—DIAMOND DRILL—A, Tin Socket; B, Diamond. FIG. 4.—POSITION OF DRILL AT WORK. FIG. 5.—CLASP OR RIVET.

The other day I paid roundly for my own experience, but at the same time I felt that I was what is called "paying my footing," as a learner of his craft, to the clever handler of drill and pliers, whom I watched, and of whom I asked many pertinent questions, as he quickly piled up the threepenny bits for riveting my pottery, my porcelain, and my glass.

His tools were four in number. A hand drill, with bits, a pair of cutting pliers, a scraper-file, and a hammer. His materials, some hard brass wire, tinned or otherwise made to look like silver, and some plaster of Paris filling for the holes.

Nothing could be simpler in construction, or, to my mind, better suited for its work than the drill, but I never saw one like it exposed in any shop for sale. It was a light steel spindle, about fourteen inches long, yoked to a wooden bar by tape, and weighted at three-fifths of the distance between its middle and lower end by a flattened ball of lignum vitæ or boxwood, with small flat faces to prevent rolling when put down.

It will easily be understood, after looking at the woodcut (Fig. 1), that when the spindle is made to revolve several times in one direction, the tape will be wound about it spirally, and the wooden bar will be raised to the position of the dotted lines. The

machine is then ready for use. Its upper end has an eye like that of a packing needle, through which the driving band of tape is passed, and its lower end is shaped conically to fit the tin holder of the *rough* diamond which bores the holes. The wooden cross bar is carefully bored through its centre, so that it will rise and fall smoothly at right angles, with the spindle upon which it travels. The way to handle this drill is to place the thumb where a cross (X) is seen in the woodcut, and the fingers, one, two, and three, where the corresponding figures are shown. This drill apparatus is entirely worked with the right hand, at any angle, leaving the left hand free to hold the piece of china to be bored firmly against the thigh of the sitting operator. Thanks to O. B. (*Jersey*) for his January note to "Amateurs in Council," I have now information which I previously had failed to get, *i.e.*, the address, 29, *Earl Street*, *Lisson Grove*, *W.*, of Mr. C. Blanchard, who offers diamond-pointed drills for sale. These are necessary for drilling glass and porcelain. It is possible to succeed in drilling pottery with a roughly-broken bradawl of good temper; but for neat round holes, made without damage by chipping off the glaze, a rough bit of diamond set in solder at the mouth of a tin tube $\frac{3}{32}$ of an inch diameter is far the best tool. The sides of this tube should be parallel for $\frac{1}{2}$ inch from the diamond point, and then widen out as a cone to fit the foot of the drill spindle. (See Fig. 3.)

Boring the Holes.—Having placed the broken pieces of china carefully together, and made up your mind where the fastenings ought to be, so as to ensure the best hold for themselves, and stability for the work when done, bore all the necessary holes along the edge of *one piece first*, about a quarter of an inch from the edge; then fit the two pieces together again, and with the point of the drill, dipped in oil, mark *opposite* to hole No. 1, the spot where in the other piece of china, $\frac{1}{4}$ inch from its edge, the corresponding hole must be. Drill this hole and repeat the marking process. Drill all holes at an angle slightly inclined towards the broken edge. (See Fig. 4.)

The Wire for the Rivets, $\frac{1}{16}$ of an inch thick, is prepared for use by being scraped or filed *nearly* half away, so as to get a flat surface for the inside of each clasp, cramp, or rivet (Fig. 5).

Making the Clasps or Rivets to fit the holes exactly is a matter first of measurement, and then of practice. It is easy to shorten them, if too long at first, by hammering one end over the nose of the cutting pliers. The way to make them is as follows: Take an end of prepared plano-convex wire, gripping a short eighth of an inch, or less, according to the depth of hole (which must never pierce the china), and hammer it a little way past a right angle on the nose of the pliers, which for this purpose it is well to grind to shape. (See Fig. 2.) The broken pieces must now be brought together again, and the bent wire having been hooked gently into its hole in one edge, it will be seen approximately where the bend must be which shall complete the wire clasp. Make that bend like the other, and cut off. If the fit is perfect, a pull with the pliers will cause the clasp to spring into its place with a firm hold, but a slight tapping with the light and well-balanced jeweller's hammer is sometimes wanted. If the clasp is too short, or otherwise troublesome, make another. When all the clasps are fitted along the line of fracture, fill up the holes with some white or coloured plaster of Paris, or other available and better-looking cement.

N.B.—Always use a lubricant with your diamond drill.

PRACTICAL SCENE-PAINTING FOR AMATEURS.

By HENRY L. BENWELL.

XIII.—TYPICAL SCENES (*continued*)—GARDEN SCENES.

IN treating on scenes of this description, I would say at once that the artist must carefully consider the subject of his design, and take care that the picture he puts on the "cloth" is suited to the period of the play he is preparing for, so that a modern town garden may not appear in a play of the Shakespearian era, nor an ancient or foreign picture be allowed to do duty in a modern English comedy. These sad defects are witnessed nightly in provincial houses, but amateurs when painting, especially for a certain piece, should not follow the bad and slovenly example of country managers, but, on the other hand, take every pains, in making or selecting their designs, to hit on a suitable and pretty subject.

It is a mistake to suppose—especially so with professional managers—that one single "cloth" of this description amongst our stock will do duty for every garden scene required. In the first place, they are very frequently wanted, more so perhaps in the standard drama and old comedy, where there is frequent change of scene, than in our modern plays; nevertheless, the fact remains that garden scenes are both varied and numerous, and the artist may, if he takes the trouble, often turn out in a garden scene a most successful stage picture.

The various types of garden scenes are many. For instance, there is the back garden of the modern town villa or mansion, with its lawn tennis or croquet lawn, and with the house tops and chimney pots in

the distance. For a specimen, remember the scene in the play of "Called Back," the design of which I think I have, and should much liked to have given here. Next, we have the grounds of the old-fashioned country house, and the low long building, with its gabled roofs and mullioned windows in the background. There is also the country mansion, with its magnificent flower-beds, its playing fountains and terrace walks, the pleasure lake in the distance, the statues and flower vases, whilst in a prominent position stands the old Tudor house itself, the whole suggesting at a glance that its owner has at some time successfully employed that rare man of talent—the landscape gardener.

Again, come views of foreign gardens, Oriental pictures with the domes and towers peeping through the foliage in the distance, whilst in the foreground the flora and fauna are in strict keeping with the locality.

Then there is the somewhat neglected Neapolitan garden, with its listless and balmy surroundings, opening out on to the sleepy canal where lies waiting for its owner the characteristic gondola. Such a picture as this is vividly described by Mr. W. D. Howells, the American novelist, in his book, "A Foregone Conclusion," a dramatic version of which is played on tour by Mr. F. R. Benson, and called "Priest and Painter.'

From the sunny south take a jump to more northern climes, such as Russia: take a peep at the gardens of the winter palace at St. Petersburg, and note the vivid contrast. I could carry the reader on for pages in the hasty descriptive sketch of typical gardens, so readily do they occur to my mind, but space forbids. My object, however, in touching thus lightly on this subject is to somewhat atone for sketches which I am longing but unable to give. If I have, however, enabled the novice to make a judicial selection as regards a design, I shall rest content that the space devoted to the subject and my time have not been made use of in vain.

The sketch, Fig. 75, which is given with this chapter, is, I venture to say, a most simple subject for the amateur or novice to attempt. It is merely a "suggestion" for a "back cloth," shall I say classical? It would, I think, be found suitable for a garden scene (on a small stage) in most of Shakespeare's plays, as, for example, Olivia's garden in "Twelfth Night." It might also prove useful in any ancient or old-fashioned piece where such a scene is required, whilst the ordinary tree wings would, at a push, match very well with it, but I would advise the use of wings to suit the "cloth." As regards colouring, the sky may be put in with a couple of shades of verditer and whiting, or if preferable, "azure" blue may be used. For the shadow part of the clouds use verditer, rose pink, white, and a little black. For the lighter masses use flake white and a little ochre, whilst for the bright edges of the clouds use flake white alone. These tints must, of course, vary according to the time of day, and nature of the sky it is intended to paint. For the distant foliage, excepting the oak on the left, make use of a purple tint. Bring the oak a little nearer. For the stonework the following colours will be found useful, viz.—Ochre, drop black, umbers, indigo, verditer, sienna, red lead, and white, according to taste.

The fountain water will require marking up with a dark tint, and touched up with cold grey, pale blue and white. For the grass use the green lakes, dutch pink, and chrome. The water in the ponds paint according to taste or as previously described.

I now come to Fig. 76, which is a sketch suggested by the scene of Margaret's garden in "Faust," now being played at the Lyceum Theatre. It is drawn from a few pencil jottings made during the performance, and represents nearly the whole of this magnificent stage picture, and is, I believe, tolerably correct, though most of the details were left to memory. The original was painted by Mr. Hawes Craven, upon whom it reflects the highest credit. This is, of course, at the Lyceum an elaborate set scene, everything in the foreground being life size. On the back cloth is painted the whole of the towers and houses in the distance. The old red brick garden wall is a set piece, the gateway being practicable. On the left of the stage is Margaret's house, with its open practicable windows, porch, and door. In the foreground, *i.e.*, on the stage itself, are shown the built flower-beds and leaning tree. The hour is sunset, and by a judicious lighting of the stage the effect is marvellous. I am not going to attempt a description of the colouring or painting of this scene, for obvious reasons, but I trust all true lovers of the scenic art will not fail to see "Faust" before it is withdrawn, if only on account of its lovely scenery and the lessons a student of scene-painting will obtain by such a visit.

I have no doubt this sketch would look very well if painted wholly on a "cloth." There is certainly one thing in its favour, it is after a painting by one of the greatest masters in this special branch of pictorial art. I may add that the scene I have been speaking of was painted from a drawing of a portion of the town of Nuremberg, Germany, the place where the plot is laid in the Lyceum version of "Faust."

Side Wings.—It is always advisable to have the wings painted to match the cloth, and the same may be said of the borders. The wings may be painted in various ways; on each may be a statue on a pedestal, with flowers at the foot and shrubs in the background.

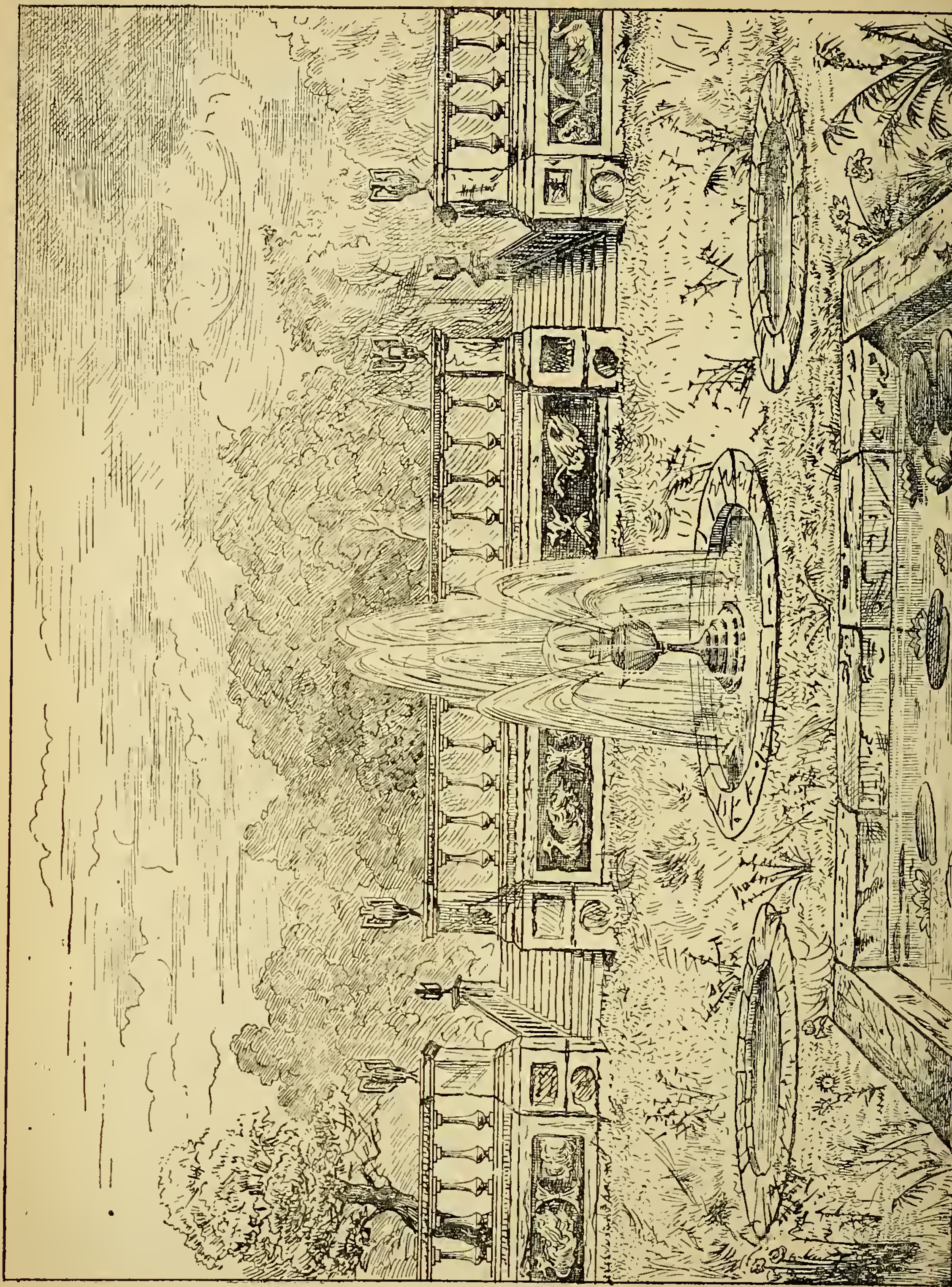


FIG. 78.—GARDEN BACK CLOTH.

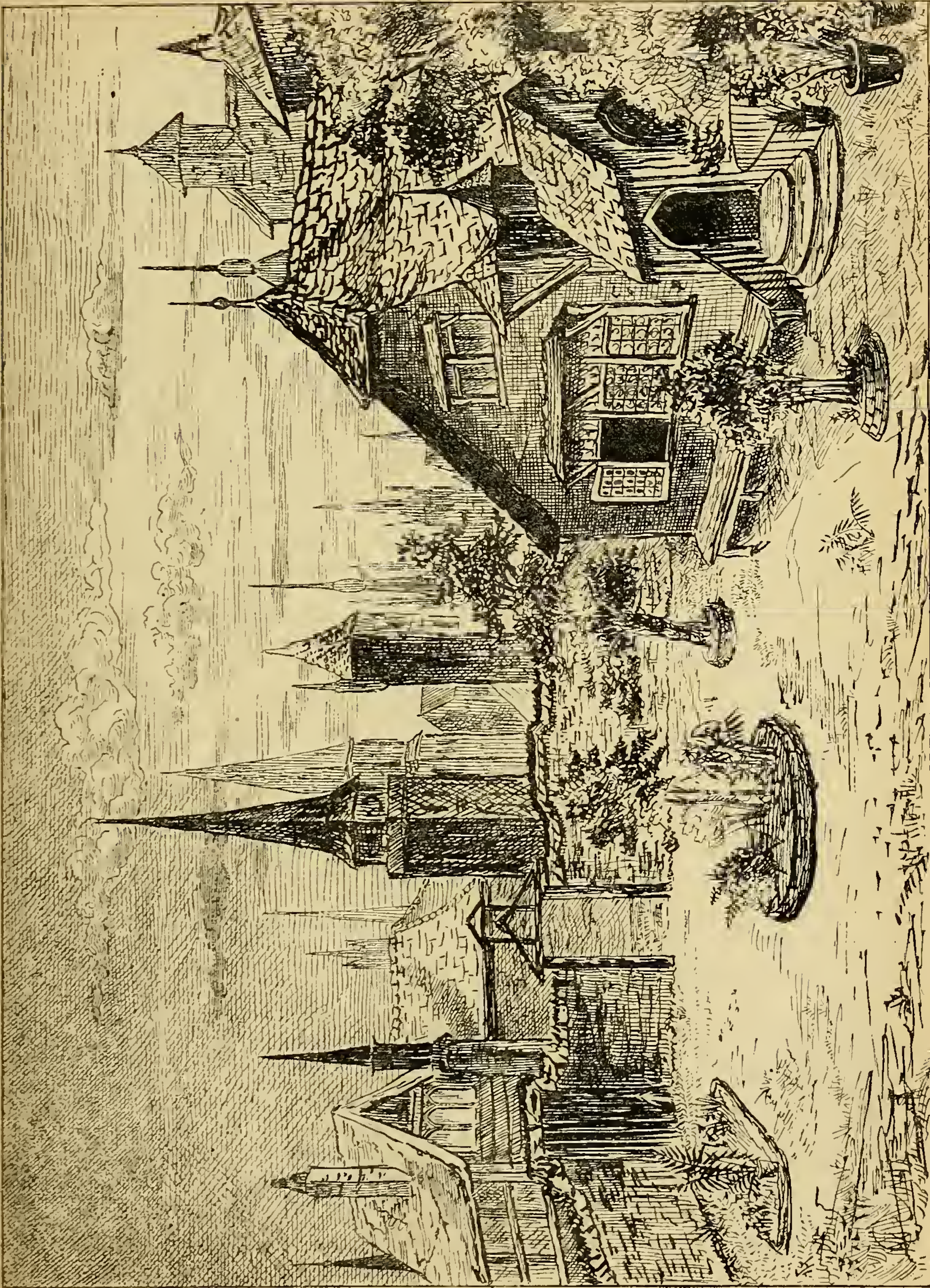


FIG. 77.—PART OF SCENE IN "FAUST" AT THE LYCEUM, REPRESENTING MARGARET'S GARDEN.

Nothing, however, looks better than a lot of rustic trellis work with creeping vines, the work running up the wings, and continued across the stage on the borders. I will endeavour to give sketches similar to this at a later period.

Garden "Ground" Cloth.—When convenient, it adds much to the reality and effect of scenes of this description to have laid on the stage a cloth, which are painted the pathways, grass, etc., whilst to prevent the actors walking where they ought not to, garden seats, shrubs, and flowers in pots may be placed on the stage.

Flowers.—A knowledge of flowers and flower painting will be found of the greatest advantage in painting a garden scene. I may add that, should the artist wish to produce rich colouring in his flowers, there is a lovely tint called "carnation paste;" it is one of the brightest colours used in scene painting, but is rather costly. In using this colour and the various lakes, *strong* size only must be used, otherwise the colours will rub off.

Built or Raised Flower Beds.—These are, of course, stage properties, and are found very useful and effective. They are particularly handy where the ground or floor cloth is used. The flower-beds in the Lyceum sketch are of this description. The top part is painted to imitate the mould, and the outside of the borders may have either tiles or box edging painted thereon. Artificial flowers in variety are inserted through holes in the top; a rose tree being best for the centre. Great care must be taken not to overcrowd a small stage with these or any other properties mentioned in previous chapters. If the stage is too full, the movement of the actors is much hampered, and their cramped position therefore tending to make them act and stand in unnatural attitudes and look like so many puppets.

Arbours.—These are often wanted in garden scenes, as in "Twelfth Night," for instance. They can be made very quickly with a lot of oak bangles, bound together with string and afterwards covered with real ivy. These look very effective.

I have no doubt said sufficient to urge the painter to use every means in his power to make not only garden, but all other scenes, as effective as possible. To make them so, every accessory for a scene should be painted expressly for it, so that in colour and effect each part shall be in harmony with the whole. It is impossible, indeed, for any scenic artist, whether professional or amateur, to pay too much attention to every minor point of detail. He will have his reward in the marked success which will not fail to attend his careful efforts to do justice in every respect to the subject that he has taken in hand.

(*To be continued.*)

A CHEMICAL LABORATORY FOR AMATEURS.

By P. CARMODY, *of the Inland Revenue Laboratories, Somerset House.*

III.—REAGENTS—LABELS FOR BOTTLES—EXAMINATION OF PAINTS.

THE next things to be attended to are the reagents, and the bottles which contain them. And first the—

Bottles.—A convenient size is 4 ounces. Preferably the bottles should be glass stoppered; and these can now be bough for about 3s. a dozen. For strong acids and alkalies stoppered bottles must be used; about half a dozen will be sufficient if a larger number cannot be obtained. Bottles with narrow mouths are best. Those who cannot procure a full set of glass-stoppered bottles must be content with ordinary bottles and corks. The stronger and more uniform they are the better; but they must not be expected to look or answer the purpose anything like so well as the glass-stoppered ones. Whether choice be made of the one or other, or partly of both, the total number required for qualitative work may vary from two and a half to three dozen.

Reagents.—The reagents necessary for qualitative work of rather comprehensive scope are the following:—

	s.	*d.*		Parts of water to be added to 1 part of salt.
Acids—				
Hydrochloric	0	5	per lb.	...
Nitric	0	7	,, ,,	...
Sulphuric	0	5	,, ,,	...
Acetic	0	6	,, ,,	...
Alkalies—				
Ammonia	0	8	,, ,,	...
Potash or Soda	1	0	,, ,,	20
Salts, etc.—				
Sulphide of Ammonium	0	6	,, ,,	...
Oxalate ,, ,,	2	0	,, ,,	24
Carbonate ,,	1	6	,, ,,	4
Chloride ,, ,,	0	9	,, ,,	5
Nitrate of Baryta	0	8	,, ,,	15
Chloride of Baryta	0	8	,, ,,	10
Chloride of Lime	0	6	,, ,,	5
Sulphate ,, ,,	1	9	,, ,,	saturated
,, ,, Magnesia	0	6	,, ,,	10
Ferric Chloride	0	9	,, ,,	...
Carbonate of Soda	0	6	,, ,,	5
Phosphate of Soda (Hydric.)	0	9	,, ,,	10
Chromate of Potash	1	1	,, ,,	10
Ferrocyanide of Potash	1	4	,, ,,	12
Nitrate of Silver	4	0	per oz.	20
Acetate of Lead	0	10	,, lb.	10

Borax	0	9	per lb.	dry
Microcosmic salt	2	4	„ „	„
Litmus papers (in books)	1	6	a doz.	...

In some laboratories dilute acids are not prepared, and kept in separate bottles. With hydrochloric and nitric acids it is not absolutely necessary to do so; but with sulphuric acid it is. For dilute acids, three parts of water and one part of acid are useful proportions. In preparing dilute sulphuric acid, special care must be taken, or serious results may follow. Use a porcelain basin or thin glass vessel; pour into it three parts of water (distilled water should be always used, and may be bought; or better, prepared, as described elsewhere in this Magazine), stand the basin or beaker in cold water, *then* pour in gradually with constant shaking one part of acid. Glass vessels sometimes crack owing to the great heat evolved on the addition of water to the acid. *Never pour the water on the acid.* It may not be out of place to remark here that strong acids and alkalies should not be allowed to touch the hands, the clothing, or anything of that nature. Should any accident occur, and strong acids or alkalies touch the skin, the best plan is to immerse the part in plenty of water; and, as acids and alkalies neutralise each other, relief may be more readily obtained if a *little* alkali is added to the water when the burn is from an acid, or a *little* acid when burnt by an alkali.

Acetic acid (other than the glacial acid) does not hurt the skin when added direct, and is, therefore, useful in neutralising the effects of alkalies. When clothing is in danger rub strong ammonia on parts touched by a strong acid; and dilute ammonia for a dilute acid. Ammonia does not hurt clothing as a rule, but potash and soda are so destructive in strong solutions that remedies can hardly be applied in time. The best thing is to take the part or article and dip it at once in plain water, or water slightly acidulated, or in vinegar (acetic acid). The other substances do not as a rule hurt either skin or clothing; but anyone ignorant of the properties of the chemicals would do well to handle them very carefully, and above all refrain from tasting them—a thing which over-enthusiastic beginners are very likely to do.

Aqua Regia.—This is often spoken of in connection with this subject; and it is necessary to know how to prepare it. It is a mixture of two strong acids—nitric and hydrochloric—one part of the former to three of the latter. It is always prepared fresh when required.

Amateurs need not buy the quantities (pounds) given in the table. Half or a quarter that amount will in most cases be sufficient. The dearer salts are used only in small quantities. For obvious reasons only the wholesale prices are given, but this will answer the purpose in view—viz., to give an idea of the probable cost.

A few additional reagents not given in the table may be wanted, and will be named as we proceed.

All bottles in use must be marked or labelled. I do not recommend labels; they soon get dirty, and give things a slovenly appearance. My plan is to mark the bottles with black japan varnish. This can be easily done. Get a piece of glass tubing, draw it to a point in the flame from gas or lamp, suck some of the varnish up this tube, clean the outside, then print away. It dries rapidly, looks well, and cannot be removed by water. The bottles can therefore be washed on the outside as often as necessary. This is how the bottle containing carbonate of soda would be marked, according to Frankland's formula:—

$$\boxed{\mathrm{CONao_2}}$$

These formulæ are the chemist's shorthand, and should be learnt if possible; but if not known, the name may be shortened thus—" Carb. Soda." By enclosing the name in lines, as above, a better effect is produced. If it is required to remove the marks, rub them with a cloth moistened with turpentine spirit (*i.e.*, the ordinary "turps" used by painters).

Having now got our laboratory, a few useful practical hints and tests may be given. It is not the object of these papers to teach the theory of chemistry; and therefore what is about to be described may be done with or without this knowledge. A good many chemical tests are every day applied by business men who know little or nothing of what the chemical changes are, but are guided by the evidence of their senses.

We will therefore begin by saying a few words on the examination of paints, as they are so common, and so commonly adulterated. The white paints in common use are white lead, sulphate of baryta, chalk and gypsum, whiting, zinc white. Suppose we have a sample of white lead to examine. This may be adulterated with sulphate of lead, sulphate of baryta, chalk or whiting. If the white lead (or any other pigment) is ground in oil, as it very frequently is, burn a little in a basin over your lamp. When it becomes dry and powdery, take a little, place it in a test tube, add dilute nitric acid, and boil, moving the test tube in and out the flame to prevent it breaking. If it all dissolves in the acid there is no sulphate of baryta or sulphate of lead present. If anything insoluble remains, pour off the liquid part, or filter it

off, and wash the insoluble with a little water, then take a piece of platinum wire, heat it in a blow-pipe flame (which is practically colourless), dip the wire in strong hydrochloric acid, and then in the insoluble place again in the flame. If the flame is coloured a light green, sulphate of baryta is present in the sample. If not so coloured the insoluble is probably sulphate of lead. The presence of chalk, gypsum, or whiting is easily determined by taking a little of the nitric acid solution above, adding dilute ammonia to it till alkaline, then ammonium sulphide until it no longer produces a black insoluble, heat, then filter off; to the filtered liquid add a little more sulphide of ammonium; if no black insoluble is produced add solution of oxalate of ammonium. A white finely divided insoluble will be formed if chalk is present in the sample. Whiting and gypsum give the same result.

Sulphate of baryta, chalk, and whiting, are seldom adulterated. Sulphate of baryta can be recognized accurately enough for practical purposes by its insolubility in acids and the greenish flame; chalk and whiting by their effervescence, and when treated the same as sulphate of baryta in the flame by the appearance of a brick red colour.

Zinc white is readily soluble in acids without effervescence. Effervescence would indicate the presence of white lead or chalk. Sulphate of baryta would be insoluble as before. If white lead were present, it could be detected by making the acid solution of the sample alkaline, and adding a drop or two of sulphide of ammonium. If it turns black, white lead is probably present.

Note.—A solution is *alkaline* when it turns red litmus paper *blue*; and *acid* when it turns blue litmus paper *red*.

Red paints are as easily examined. The chief red pigments are: Red ochre, red lead, vermilion, chrome red. Natural ochre consists of a clay containing oxide of iron. If a sample therefore be boiled in aqua regia until only a white, or nearly white, insoluble remains, and this insoluble be tried at the blowpipe, sulphate of baryta will be detected by the green flame. If the flame is not coloured, the insoluble is probably the silica of the clay. The presence of chalk would be detected by effervescence on the addition of an acid. These are the two most common adulterants of ochres.

Red lead cannot be easily dissolved. Nearly concentrated nitric acid, however, dissolves it readily if a drop or two of alcohol or methylated spirit be added to the boiling acid solution. This must be done carefully, and the brown fumes given off must not be inhaled. If any white insoluble remains, it is an adulterant—probably sulphate of baryta. Test at the blow-pipe as before. Chalk, if present, would be detected by the effervescence on addition of acids.

A generally reliable test for vermilion is to heat a little in a basin over a gas flame. If after heating strongly anything considerable is left it is an adulterant, and the extent of the adulteration may be inferred from the amount of ash left. As vermilion is a very important pigment, it is often adulterated. A vermilion may be pure and yet of poor quality. The more brilliant the colour the better. Comparison with good samples will enable one to judge of its quality.

A good practical test for all coloured pigments is to compare the sample under examination with a standard sample in the following way: Take a small measure of the pigment, mix it with an equal measure of chalk, sulphate of baryta, or other white pigment. Take another measure and mix with two measures of chalk; another, and mix with three; and so on up to six measures of chalk. Do exactly the same with the standard sample, which should be the best procurable, and compare the tints of corresponding mixtures. The best pigment is that which has the greatest colouring power, and an inferior sample will readily be detected in this way.

Chrome red is another important red pigment. It is sometimes largely adulterated, so much so indeed that it would be out of place to describe here the methods of detecting the adulterants used. Chrome red should contain only lead and chromium. It should dissolve readily in nitric acid, should not effervesce, and should be of a rich red colour. The mixing test is perhaps the best guide for amateur chemists.

(*To be continued.*)

A SMALL OCCASIONAL TABLE.

By WILLIAM PRIDAY.

THIS table, which I venture to place before my readers, was made after working hours. I began on the Monday, and working steadily, say two hours each night, it was finished complete by Saturday, only I should say that on that day I had half a day more to finish it in. As I am very fond of flowers and plants, I found that this table, when made, was just the very thing to suit my requirements. On the shelf, underneath the table top, I have my ferns and goldfish in globe, they have enough light when at the window, and the sun cannot get at them too much. The table top is level with the bottom of the window for the display of cut flowers and plants;

I also have china nick-nacks on the lower shelf amongst the ferns.

First of all we shall have to consider what sort of wood we shall use. The only parts seen are the legs, which are square, and this form for them will be an advantage to young amateurs who do not possess a lathe. The legs can be made of any hard wood—mahogany, walnut, oak, etc., and when finished they can be polished. If the materials named are too expensive, get some pitch pine, and have them stained and varnished, or varnished without staining, or painted a rich brown, in which colour I have painted mine. That they are merely painted will not be noticed much, as I am frequently asked, "Who polished it for you?" and enquirers cannot believe but that what they are looking at is made of some expensive wood, until they have examined the table more closely. Supposing then that we determine to make the table of pitch pine, it can be got cheap from any dealer; one or two treads of a stair will set you up for the legs and cross-pieces, and in all probability there will be many an odd piece of thin $\frac{1}{4}$ inch deal knocking about at home that will do for the top and shelf, if not you will get all you require at any timberyard for a few shillings.

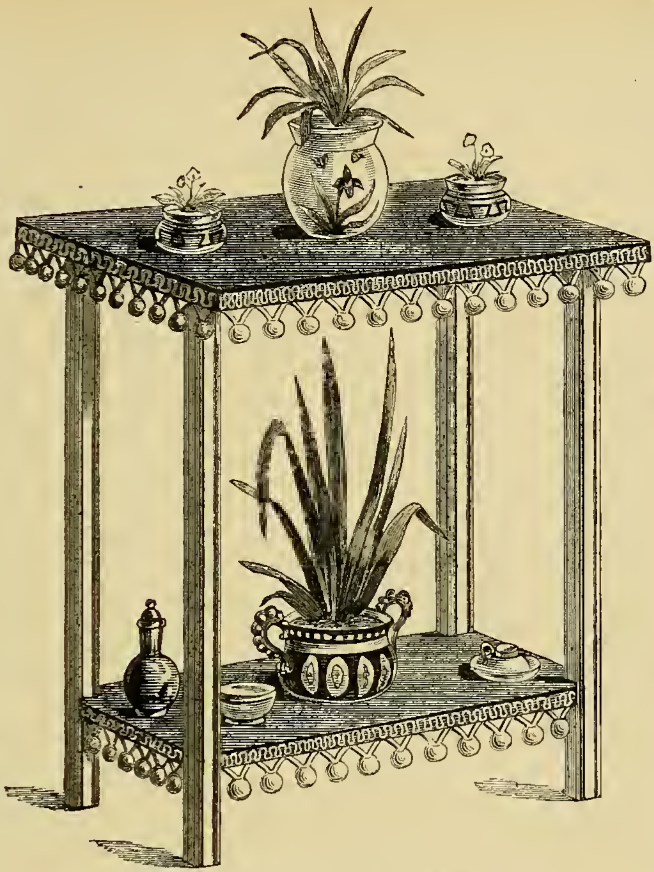


FIG. 1.—SMALL OCCASIONAL TABLE—PERSPECTIVE VIEW.

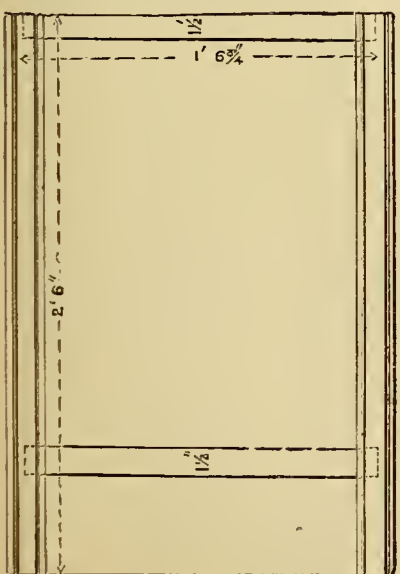


FIG. 2.—LEGS AND RAILS—FRONT ELEVATION.

FIG. 3.—ATTACHMENT OF SIDE PIECES.

Cut up the pitch pine for the legs; the length of the legs must be 2 feet 6 inches, and the thickness when planed and finished off is $1\frac{1}{8}$ inch. Having got four of these, now get out the four longer cross-bars, it does not matter what sort of wood—ash, pitch pine, deal, or any kind of wood will do for them, as they will be painted after. The cross-bars are $18\frac{3}{4}$ inches between the front legs, and $9\frac{1}{2}$ inches between the side legs. The cross-bars, moreover, are of the same thickness as the legs.

Having got these sawn out and planed, getting two sides true to square from, take two legs and two front cross-bars, lay them on the bench, if large enough, if not put them on the floor whilst you mark them

FIG. 4.—SECTION OF LEG.

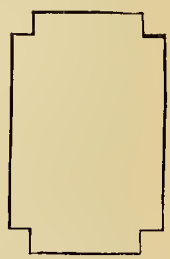


FIG. 5.—PLAN OF SHELF.

out for the tenon and mortise, as shown in Fig. 2. The cross-bar at the top must be flush with the top of the leg to allow the table top to rest on it. Having marked and numbered them for tenon and mortise, now fit together again. When you have finished one lot do the other in exactly the same way. When this is also done, get the side cross-bars planed 9½ inches long. These cross-bars must be cut off square at the ends, as they are not mortised but only screwed on the legs that support them. When all have been got quite ready the amateur will do well to compare all the legs together, and to do the same with the cross-bars to see that they are all of a size. When we have found that all is right, get the four legs smoothed with a smoothing-plane very finely ; then get your beading-plane and run a beading up each side, which will make two beads to one side, eight beads in all, see Fig. 4. Now get two legs and two of the longer cross-bars and your glue ready, and then glue and clamp up ; if you have not got a clamp, put one leg against the wall and let it rest flat down on the floor, and put a nail or two in the floor to keep it in its place. No nails have to go through the tenons, as they are reserved for screws. For the side cross-bars, see Fig. 3. Serve each end of the table in the same way. When these are both finished, bore holes through the legs—cutting right in the middle of the tenons and mortise—for the screws. Having bored and countersunk for the screw heads, put one of the side cross-bars in place and screw up fairly tight, as shown in Fig. 3. Get all the four shorter cross-pieces on, then lay the work as it were on its face downwards, and the four cross-bars will be sticking up. Now get the other half and screw it to the cross-bars in same way. You will want long thin screws, about 2 or 2½ inches long.

Having finished screwing, you can now let the frame of the table stand on its own legs. Get a plumb line and try each leg to see if it is straight, as they shift about when screwing them up, and try the corners with a square, for now is the time to alter before the glue has set. Knock here and there to get it right, then leave the work for a day to harden the glue.

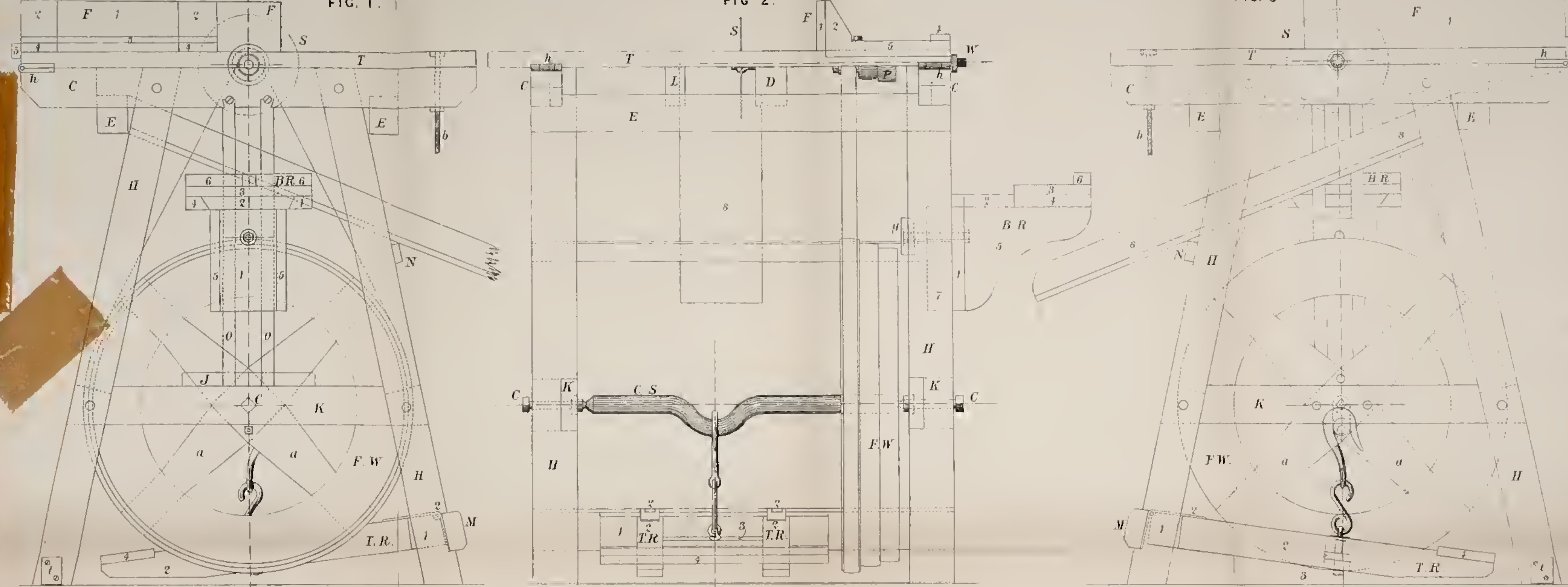
In the meantime get your table top and shelf ready. First of all get the shelf ready ; the four corners are cut away to admit the legs at the side when fitted, as in Fig. 5. The sides are flush all round with the legs : the shelf should rest nicely on the cross-bars, and if this is found to be case, screw or nail the shelf down. This done, get the table top, it should project about three inches over the frame all round ; get this right, see that it rests on the frame all round, and then nail down.

We have now done all the joinery, we can give the table a good sandpapering and take all the superfluous glue off with an old chisel. It is now quite ready for painting. To do this get some sienna, grind it in turpentine and varnish ; first grind with turpentine to a stiff paste, then add varnish to thin it, but not too much. When the first coat is dry, fill up the holes and joints with putty. To make the filling, get some whiting and put some of your paint in it. Now give the work a good sandpapering, and put on another coat of paint ; the legs must be painted until you cannot see the grain of the wood. Great care must be taken when sandpapering the corners, as we are apt to rub all the paint off. Do not be afraid of using the paint, but put on plenty. When the paint is dry wash and wipe it with a wash leather, and then give it two coats of varnish. Be sure to wash the work after each coat of varnish, otherwise the varnish would not stick to the paint but would run off. If you prefer to do so you could ebonize the table as follows. Provide yourself with some japan and then give the table a coat of dead black—that is to say, black paint that will dry in ten minutes or so, and after giving it a coat of this, give it two or three coats of japan. Not much sandpapering is required in this work, for only No. 1 sandpaper should be applied after the first coat, as japan is easily scratched. Do not sandpaper the last coat. When it is dry get some ground pumice stone, clean water, sponge, and wash leather ; put your pumice stone powder in a saucer, with some water, get a piece of cloth, not rag, fold up your cloth like a pad, dip it in the water then in the pumice stone powder, then rub lightly over the japan. Continue the rubbing until it is dull all over ; of course, it does not want varnishing. Be sure to wash the powder off well with clean water and wipe over with leather.

Now for the upholstering. You can have the table covered with plush or moreen, but if you have it standing in a window you will, like me, have light moreen. It will take about half-a-yard, at 4s. 6d. per yard, and about four yards of fringe at 5d. or 6d. per yard. The colour of the upper part of the fringe is light red and black, which corresponds with the cloth. The strings to the bobs are dark green ; the bobs are a whitish green with red in centre ; the green and red set the table off nicely.

Get your cloth over the table top, allow it to be turned underneath, then cut off what you require. This should be stretched tightly, and tacked at the edges all round. Now do the shelf in the same way, letting it come down at the sides a little all round, care being taken to make it fit nicely all round the legs. Stretch the cloth when tacking it, or it will have creases in it when finished. Now get the fringe, where it has to be cut tie the ends with black cotton

FIG. 1. FIG. 2. FIG. 3



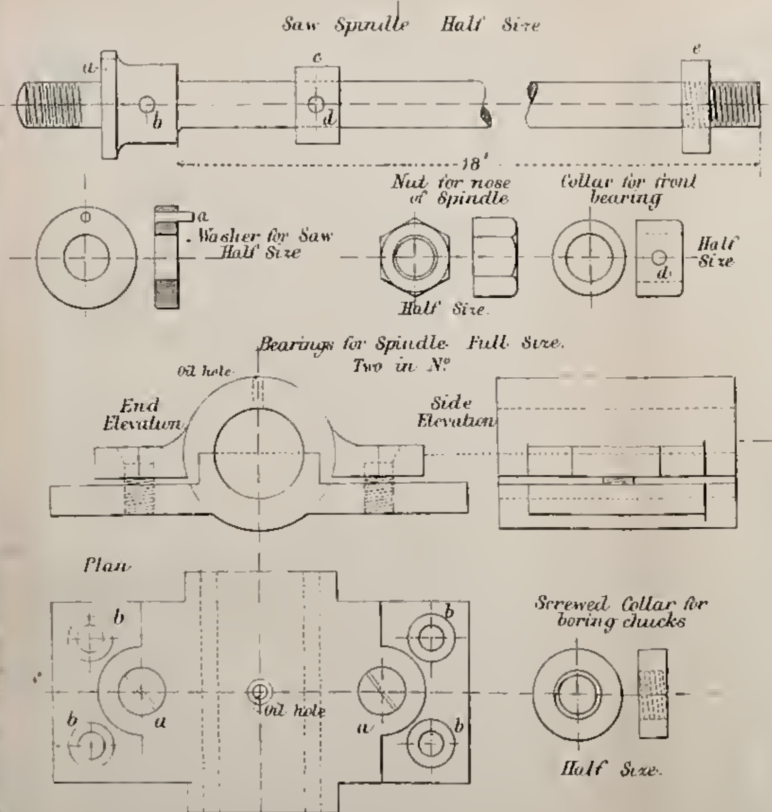
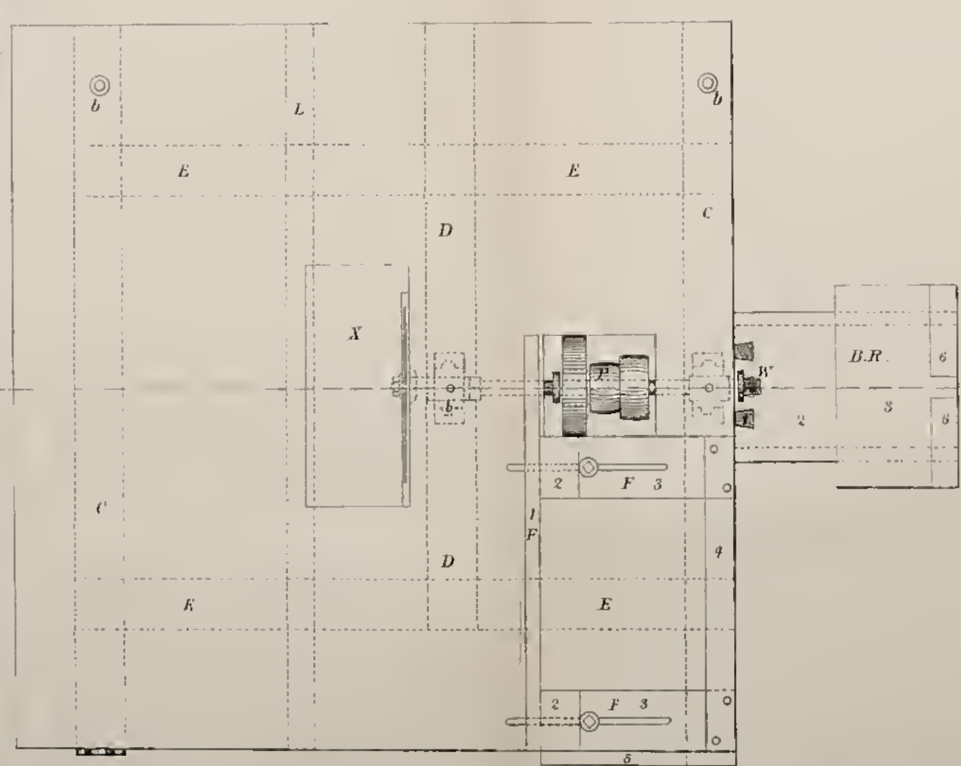


FIG 4.



CIRCULAR SAW BENCH

WITH

PLANING, GROOVING, REBATING

AND

MORTISE BORING ATTACHMENTS.

Designed specially

FOR AMATEUR WORK BY

"OLLA PODRIDA"

Scale, 2 Inches = 1 Foot or 1/6th full size

REFERENCES.

FIG. 1. Right-hand end elevation, showing boring rest.
FIG. 2.—Front elevation.
FIG. 3.—Left-hand end elevation.
FIG. 4.—Plan, showing apertures for Pulley and Saw.

WARD LOCK AND CO., WARWICK HOUSE, SALISBURY SQUARE, LONDON, E.C.

to keep it from coming unwoven. Tbis goes all round the table top, but not so with the fringe on the sbelf, where it only goes from leg to leg. Be sure to tie the ends witb cotton, or tbey will certainly come unwoven. Tbe fringe should be nailed with small black pins, so as not to be seen. This mode of putting it on makes the fringe and cloth look all of one piece.

CIRCULAR SAW BENCH,

WITH PLANING, GROOVING, REBATING, AND MORTISE-BORING ATTACHMENTS.

By OLLA PODRIDA

(*For Figs.* 1—4, *see Folding Sheet issued with this Part.*)

I.—INTRODUCTION—CAPABILITIES OF THE MACHINE—DETAILS OF FRAMING, ETC.

THIS machine was originally designed to carry a circular saw only, but on considering the matter, the writer concluded that a small planing attachment would prove very serviceable, especially to those who intend "going in" for flower-stands, over-mantels, etc., in the Japanese style of framework. For the latter class of work, and for Oxford framing, a small planer is invaluable, if only for the purpose of "roughing" out the stuff within reach of a finishing touch from the smoothing plane. The addition of the planer attachment led to "other tbings," partly enumerated in the title of this article, the addition of which entitles the macbine to rank, in a measure, with a universal joiner. As will be evident, it is far from being universal in its scope, when compared with the "Universal Joiner" of a cabinet-maker's works, nevertheless, the amateur of reasonable requirements, will, I venture to predict, find that it will deal, as a labour-saving tool, with a large variety and quantity of work.

The machine, as designed, is intended to carry a saw 8 inches in diameter, which may be run at a rate of 800 to 1500 revolutions per minute. The maximum depth to which it will cut is about three inches, but at this depth very little work must be expected: a little cross-cutting may be done, but it would be unreasonable to expect any despatch, the machine being designed to cut inch, or at the outside, inch and a half stuff. It will split a board 12 inches wide with the fence in place, and with the fence removed, split or cross-cut any width or length depending on the situation or room in which the machine stands.

The planing contrivance will be described later on, with the assistance of a special Folding Sheet, devoted to this particular attachment. It may, however, here be stated, that it is designed to plane stuff up to 2 inches wide or square, one side at a time. The grooving will be accomplished by means of the saw, and will range from the width of the saw "kerf," or cut up to about half inch by three-quarters of an inch deep. For grooves beyond the width of "kerf," the saw will be made "drunken," the degree of "drunkenness" being regulated by the width of groove. Rebating may be accomplished in four ways: First, by sawing out the rebate in two operations; second, by means of the "drunken" saw; third, by means of the planing attachment; and fourth, by means of the boring rest. Mortise boring is accomplished by means of suitable bits, held in chucks screwed on the right-hand end of saw spindle, at W (see Folding Sheet), the work being carried by the adjustable rest, marked B R. Mortise holes, 4 inches deep by $1\frac{1}{4}$ inches wide, may be bored in this manner, and the tenons may be sawn out by means of the circular saw. By attaching suitable wooden chucks at W, a face or chuck lathe may be extemporised, by which a deal of work may be done with some assistance in "treadling." A small grindstone, emery, or polishing wheel may also be attached at will, but such creators of grit are best kept away from machines for which any respect is entertained. Light metal work may also be drilled with facility.

With reference to the Folding Sheet, a brief description of the principal features of the machine may not be out of place, and likely to promote a more ready comprehension of the general arrangement. Fig. 2 is the front elevation, giving the general appearance from the stand point or position of the operator. The letters of reference are the same for similar parts in all the views. S, is the saw; F, the fence; T, the table, adjustable by means of the hinges at *h*, *h*, and bolts, at *b*, *b*; L, is a ledge for stiffening the table C, C, D, and E, E, are the members of the upper part of framing; P, is the pulley on saw spindle; H, H, H, H, are the legs; K, K, the cross-pieces carrying the crankshaft, C S, and flywheel, F W, by means of the centres, *c*, *c*; M, is a cross-bar, serving the double purpose of tying the back legs together, and supporting the treadle, T R, by means of the hinges at Q, Q; *t*, is a hoop iron tie for the front legs; *s*, is a shoot for carrying away sawdust, etc., clear of the driving gear beneath; N, is the support for the shoot; B R, is the boring rest, carried by two perpendicular members, O, O (Fig. 1), and secured to them by means of a plate and bolt at *g*; *a*, *a*, are the flywheel arms; (Fig. 4), is a portable piece, fitting into the top of table, so that it may be removed to admit of a change of saws, or the fixing of the planing attachment. Fig. 1 is an elevation of the right-hand end of Fig. 2, and shows the boring rest with its supports, profile of flywheel, back of fence, and general arrangement of

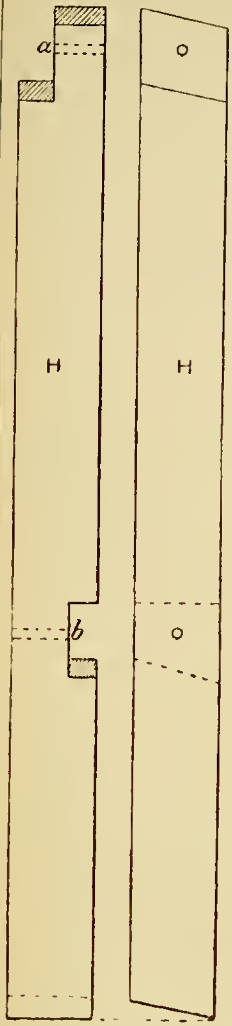


FIG. 5 —LEGS.

Four in Number, Two Right, Two Left Handed.

DETAILS OF FRAMING.

Note. — All the Figures are drawn to a Scale of one and a-half inches to one foot, or one-eighth full size. But figured dimensions are, where given, to be used.

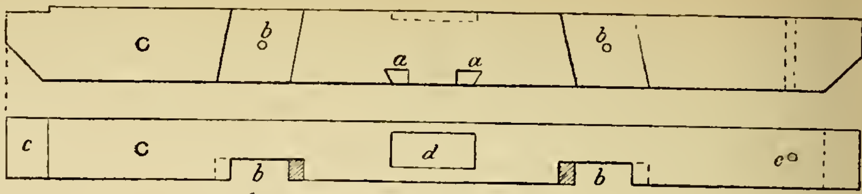


FIG. 6.—CROSS-PIECES FOR UPPER ENDS OF LEGS.
Two in Number, One Right, One Left Handed.

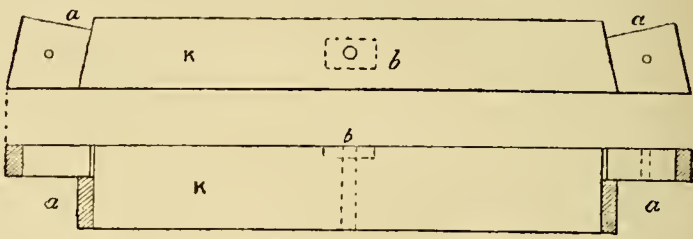


FIG. 7.—CROSS-PIECES FOR CRANKSHAFT CENTRES.
Two in Number.

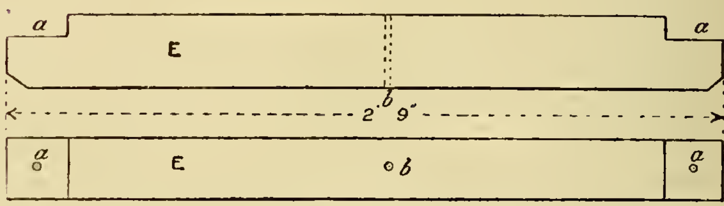


FIG. 8.—LONGITUDINAL PIECES FOR TYING FRAMING AT TOP, AND FOR CARRYING SUPPORT FOR SAW SPINDLE.
Two in Number.

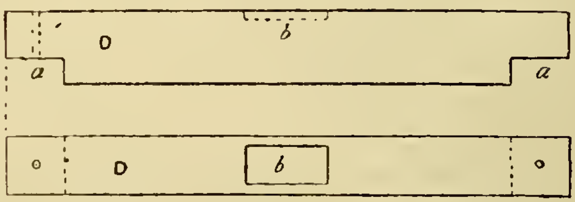


FIG. 9.—CROSS-PIECE OR SUPPORT FOR NECK OF SAW SPINDLE.
One in Number.

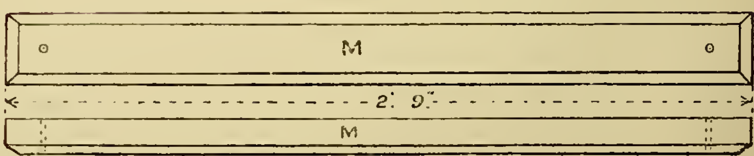


FIG. 10.—TIE BAR FOR BACK OF LEGS AND FOR CARRYING TREADLE.
One in Number.

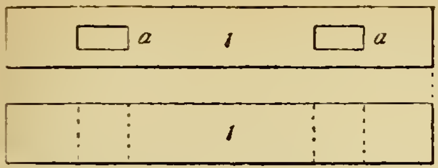


FIG. 11.—BACK PART OF FRAME FOR TREADLE.
One in Number.

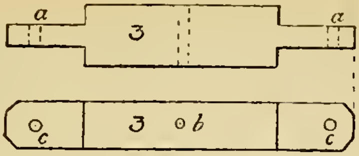


FIG. 12.—CROSS-PIECE BETWEEN TREADLE ARMS FOR TAKING CONNECTION TO CRANK.
One in Number.

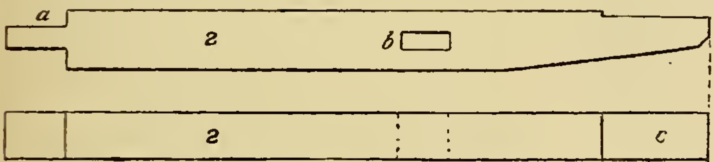


FIG. 13.—ARMS OF TREADLE.
Two in Number.

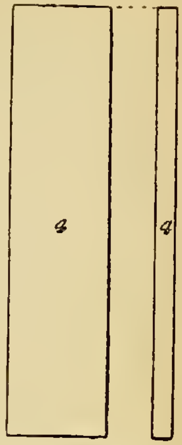


FIG. 14.—FOOT-BOARD FOR TREADLE.

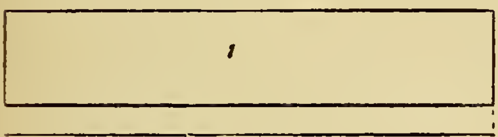


FIG. 15.—FRONT PART OF FENCE.
One in Number.

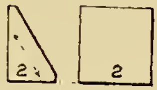


FIG. 16. — ANGLE PIECES FOR FENCE.
Two in Number.

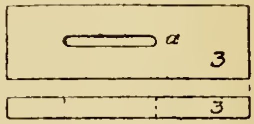


FIG. 17.—FEET FOR FENCE.
Two in Number.

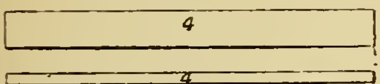


FIG. 18.—STRAP FOR TYING FEET OF FENCE.
One in Number.

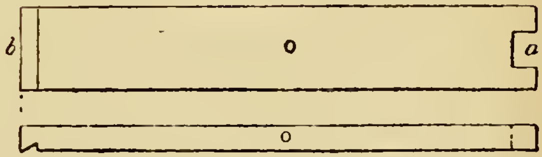


FIG. 20.—SUPPORTS FOR BORING REST. Two in Number.

DETAILS OF WOODWORK.

NOTE.—All Figures are drawn to a Scale of one and a-half inches to a foot, or one-eighth full size.

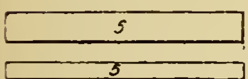


FIG. 19.—LEDGE FOR KEEPING FENCE SQUARE.
One in Number.

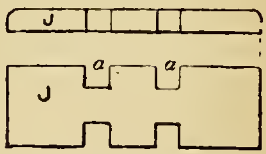
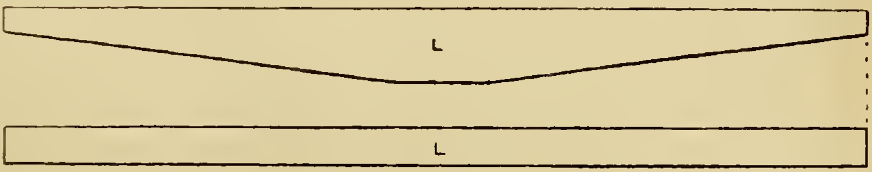


FIG. 21.—CHOCK FOR SUPPORTS TO BORING REST.
One in Number.

FIG. 22.—LEDGE FOR UNDERSIDE OF TABLE.
One in Number.



the legs and cross-pieces for supporting the crankshaft. Fig. 3 is an elevation of the left-hand end of Fig. 2, and gives a good idea of the construction of the treadle. Fig. 4 is a plan of the machine as it would appear if the operator stood in front and looked down upon the top of the table; the dotted lines give the arrangement of the framing immediately beneath the table. The apertures for saw and pulley are also clearly shown, and a good idea given of the fence, and its mode of adjustment, the boring rest, and the position of the bearings in dotted lines. All these figures are drawn to a scale of 2 inches to the foot, or one-sixth full size. In the left-hand lower corner are details of the saw spindle and its washer, nut, and collars, also three views of the bearings for saw spindle. Particulars of these parts will be given hereafter, with instructions for making the patterns for the bearings and cap.

As will be observed, the whole of the framing, also table, fence, boring rest, treadle, flywheel, and pulley is of wood, which brings such a machine well within the reach of an amateur possessing a little knowledge of carpentry. If that knowledge is wanting, consult "Every Man His Own Mechanic," and this will go far in promoting an acquaintance with that, as also with many other crafts. The necessary metal parts may also easily be obtained; the crankshaft can be made by an intelligent smith, as also the centres for the same. Most of the bolts and all of the hinges can be obtained, at an ironmonger's. The spindle and bearings may be obtained at very reasonable rates from the Britannia Company of *Colchester*, and at slightly cheaper rates if the purchaser finds his own patterns for the latter. The saw, which should be a stout one, with moderately coarse teeth, can be obtained from Melhuish or Churchill, who will furnish catalogues and prices on application. As already stated, the planing attachment will be treated separately in conjunction with a special Folding Sheet.

We may now proceed with the details, for the preparation of which brief instructions will accompany each prominent part.

Framing.—Each pair of legs, when complete, may be considered as a frame in itself, forming one side of the machine, these sides being tied together at the top by means of longitudinals E, E, of the form and dimensions given in Fig. 8, and at the back by means of the tie-bar M, Fig. 10, for carrying treadle, the front legs are tied at the floor line by means of hoop iron. The legs are shown at Fig. 5; each one will require a piece of stuff 3 feet 6 inches long by 3½ by 3½ inches. The cross-pieces for upper ends of legs are given in Fig. 6, each of these will be 3 feet long by 3⅓ by 2⅝ inches in the rough. The cross-pieces for carrying crankshaft are given in Fig. 7; each of them is 29 inches long by 3⅛ by 3⅝ inches in the rough. The best way to frame the legs, after planing up the stuff, will be to lay them on the floor at the proper angle, which should first be lined out in chalk or pencil; then lay the upper cross-piece on top, at its proper distance from the bottom ends of the legs, and mark lines across the upper face of both legs on each side of the cross-piece, also lines across the under side of cross-piece, on each side of each leg. The cross-piece and legs may now be let into each other, as shown at *a*, in Fig. 5, and *b*, in Fig. 6, being preferably secured by bolts, although stout wood screws, two in each joint, would answer very well. After fixing them together, lay them down with cross-piece underneath, and put Fig. 7 on top, keeping it parallel with the cross-piece and at the correct distance from it. Draw lines across the legs on each side of the second cross-piece, and also across itself on each *inside* of the legs. The upper lines on the legs must be squared down from the outside edge, to form the dovetail at *a*, Fig. 7. Now let them into each other, making a tight fit of the job, bolt together, and bevel off the lower ends of the legs parallel with the cross-pieces. The recess for bearing at *d*, in Fig. 6, as also at *c*, for hinge, and the hole at *e*, for bolt and dovetails at *a*, *a*, must also be left until the frames have been fitted together complete, so that greater accuracy may be ensured in marking of their position. After the legs have been framed together, the longitudinals shown at Fig. 8 must be prepared and fitted. They are each 2 feet 9 inches over all, and 25 inches between the shoulders at *a*, *a*, by 3 inches wide and 2½ inches thick. The hole at *b* takes the bolts for securing the cross-piece shown in detail at Fig. 9, which is 2 feet long by 3 inches wide, and 2½ inches thick; the distance over the shoulders is governed by the longitudinals; it should therefore be marked after these are in place. It may here be observed, and attention drawn to the fact, that the letters and figures of reference used in the Folding Sheet and general description are carried on in the details, each part bearing its distinguishing letter in capitals, and each detail its corresponding figure.

Fig. 10 calls for no particular remark. The length over all is 2 feet 9 inches, and the scantling 3 by 1½ inches. In fixing this, see that the pairs of legs are parallel with each other, until this has been proved the holes for bolts—one at least—should not be bored.

The recesses for plate nuts and holes for centre screws forming crankshaft centres may now be made and bored. In making these, divide the cross-pieces between the legs and mark centre lines across K, K, and on each side and across the top of the cross-pieces C, C, and D. These lines will be the guidance in letting in the bearings for saw spindle.

Treadle.—This may now be framed and put together ready for hanging. It consists of a back piece, Fig. 11, into which two arms, Fig. 13, are securely mortised at *a*, *a*. These arms are tied together by the cross-piece, Fig. 12, which also takes the connection for crank. Fig. 12 is tenoned into the arms at *b*, and secured by pins at *c*, *c*. At *b* the connection to crank is secured. The arms are further stiffened by means of the foot board, Fig. 14, which is screwed firmly to them at C. In obtaining the dimensions of these members it is only necessary to measure accurately the drawn size, and multiply by eight to obtain the actual full size.

Fence.—Fig. 15 gives the front part of the fence which should, if possible be made of mahogany, sound and well seasoned. The feet shown in Fig. 17 are secured to the front part by means of the angle pieces given in Fig. 16. In the left hand view in this figure two arrows will be seen, these denote the direction that the grain of the wood should occupy when the pieces are cut out. The feet are slotted, as shown at A, Fig. 17, for the holding down or adjusting screws. Fig. 18 is a stay or strap for tying the feet together and thus giving firmness to the whole. Fig. 19 is a ledge piece screwed to the front edge of the front foot, and fitting against the front edge of table, so that it may form a guide in keeping the fence square, or rather parallel to the saw.

Supports for Boring Rests.—Fig. 20 shows these in detail. They are, as has already been seen in Fig. 1, Folding Sheet—dovetailed into the cross-piece, C, at the upper end and secured at the lower by means of a shoe, marked J in Fig. 1, and given in detail at Fig. 21. The end marked *a*, Fig. 20, steps or fits tightly into the provision at *a*, *a*, Fig. 21. The dovetail part, shown at *a*, Fig. 20, should be fitted into the cross-piece first, then the supports cut to the proper length and the lower ends fitted into the shoe. The supports must be put into the shoe, and the whole lot "shipped" into place together, after which the shoe must be firmly screwed to the lower cross-piece, K, and the upper ends of the supports "stopped" by means of screws inserted in dovetail joint, as shown in Fig. 1.

The ledge for stiffening the table is shown in Fig. 22 in page of illustrations, 321. It calls for no particular remark at present, but may be referred to when the table is under description in the next chapter, which will be devoted to that and details of the boring rest.

[In Figs. 1 and 2 it will be noticed that the centres *c*, *c*, which carry the crank-shaft C S, are lettered in capitals instead of small italics. In Fig. 3 the letter *c* is omitted. Readers will please note these points, and rectify them for themselves in the Folding Sheet.—ED.]

(*To be continued.*)

HOW IT WAS MANAGED.

A SERIES OF PRACTICAL HINTS, SUGGESTIONS, AND WRINKLES.

FROM AMATEURS FOR AMATEURS.

XV.—A SIMPLE LEYDEN JAR FOR "OUR BOYS" TO MAKE.

[*From D. B. ADAMSON.*]

WISHING to make and assist my boys to make an elementary set of electrical apparatus for their amusement and instruction during the coming winter, I turned, in Vol. II. of AMATEUR WORK, to the article called "How to Make a Cylindrical Electrical Machine," for any hints that might be useful, and, while reading the author's instructions about the Leyden jar, I remembered one I used when a boy. As it is so simple that it can be made by the "merest schoolboy"—not the ideal one, but the ordinary flesh-and-blood specimen of juvenile manhood—I think it may be useful to those who, among other things, wish to teach their youngsters to make the most of simple means, and not to despise a homely piece of scientific apparatus. Any bottle will do. Say an ordinary wine bottle is looked up, cover it to within two or three inches of the neck by pasting on tinfoil, which should be laid smooth, and neatly trimmed off at the top edge. Put water inside to about the height of the tinfoil; a piece of wire long enough to reach to the bottom of the bottle, and projecting two or three inches above the neck, is also required; a steel knitting-needle, piece of bell wire, thin metal tubing, or anything similar, does very well. On the end projecting from the bottle put a knob of metal, such as a bullet or metal knob that has no sharp edges or corners. In lieu of metal, a cork, rounded off and covered with tinfoil, answers every purpose. If my memory does not fail me, in the original of the one I describe an old brass door-knob was used. The wire can be run through a cork in the neck of the bottle, but it is not necessary. The Leyden jar is now complete, and, though made of the roughest and commonest materials, it will be found as useful, if not as handsome, in appearance as any, while to "our boys," it will no doubt afford increased pleasure from being their own handiwork. Let us who are men encourage the dear, mischievous little fellows to develop any mechanical ability they may possess, and remembering our own early efforts, "despise not the day of small things." As Chas. F. Adams, in one of his inimitable poems on babyhood, "Dot Baby of Mine," expresses it, "Dese leedle shafers vas going to be men"—the men of the next generation, who, let us hope, without disparagement to our noble selves, will excel their fathers in every good word and *work*.

XVI.—TWO CHINESE NOTIONS.

[*From "WAITO."*]

THE two notions I propose to introduce to the readers of AMATEUR WORK are, firstly, a substitute for our English chalk line, and, secondly, a small appliance, which I think

is an improvement on the bit of grease in a paper with which in England we are accustomed to lubricate our saws.

The first of these articles is represented by Fig. 1, and may be made either in a box form, with a partition in the middle, or the two chambers, A and B, may be hollowed out of a solid block of wood; in either case the outside measurement should be about 5 inches long by 3 inches wide by 2 inches deep. Having made this part of the apparatus, form a piece of stout brass wire into the spindle with a handle C, and place it in compartment A; then with a long drill or a red-hot wire, pierce the two holes D and E. Next take a fine line (an undressed fly-fishing running line would

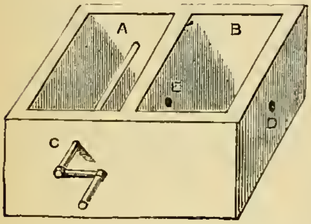


FIG. 1.—SUBSTITUTE FOR CHALK LINE.

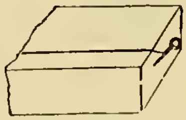


FIG. 2.—DIAGRAM SHOWING MODE OF USING LINE.

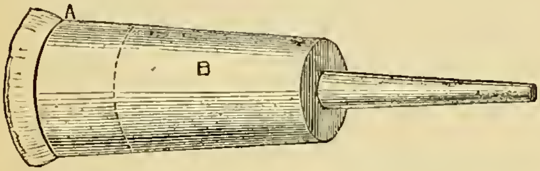


FIG. 3.—CHINESE LUBRICATOR FOR TOOLS.

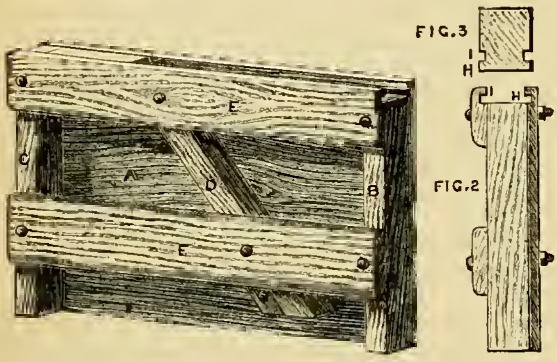
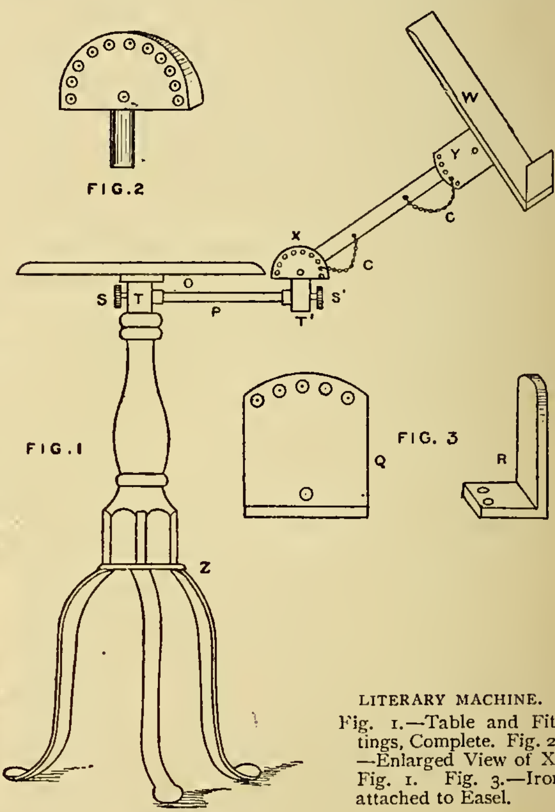


FIG. 1.—MITRE PLANER, COMPLETE. FIG. 2.—END VIEW OF MITRE PLANER. FIG. 3.—END VIEW OF PLANE.

answer well), and passing it through the holes at D and E, fasten it to the spindle G, and wind it up; then fill the compartment B with shreds of rag or some tow, and soak them well with Indian ink and water. Next, to the outside end of the line fasten a sharpened iron spike about 1½ inches long. If to the head of the spike you fasten a good-sized leaden bullet, you will find it useful while drawing in the spike, which is usually done with the palm of the hand; and it will also enable you to use your line as a plumb-line.

Having described the apparatus, I will now give some hints in using it. Proceeding to one end of the plank to be marked, strike in the spike, as shown in Fig. 2, in such a position that the line shall bear against the upper corner of the work, then walking backwards, allow the line to unwind itself. As it passes through the tow and Indian ink it will be covered with a black coating of the ink. Should it not take well, press on the top of the tow with a piece of wood. Arrived at the other end of your plank, take two or three turns of the line round the handle C, to prevent it unwinding further, and proceed to strike the line as you would with an English chalk line. Wind up, and you are ready for next time. The ink requires constant moistening. A Chinese carpenter rarely uses a pencil, but substitutes it, with a piece of flat bamboo or rush he dips into compartment B, and uses like a pen. A ruler he never uses, all lines being marked with the apparatus I have above described.



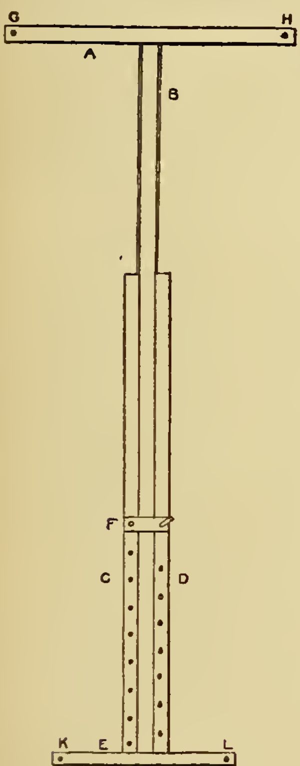
LITERARY MACHINE.
Fig. 1.—Table and Fittings, Complete. Fig. 2.—Enlarged View of X, Fig. 1. Fig. 3.—Iron attached to Easel.

The other notion is simpler to describe. It consists of either the smaller end of a cow's horn, or of tin, fashioned as in Fig. 3; the horn or tin tube being about 4 inches long. At the larger end A, insert a strip of flannel about 1 inch wide, and very tightly rolled up. Before putting in the flannel, fill the vacuum B with any common sort of oil, and then ram in the flannel, leaving about ¼ inch protruding. Allow the oil a few minutes to percolate, and then use it as a brush. This little appliance will be found most useful in lubricating saws and oiling down tools—a very necessary operation, when you are in a hot climate. One wrinkle must be added: Keep the end A uppermost when not in use, otherwise the oil will drain out and stain articles which do not require oiling.

XVII.—MY "LITERARY MACHINE."

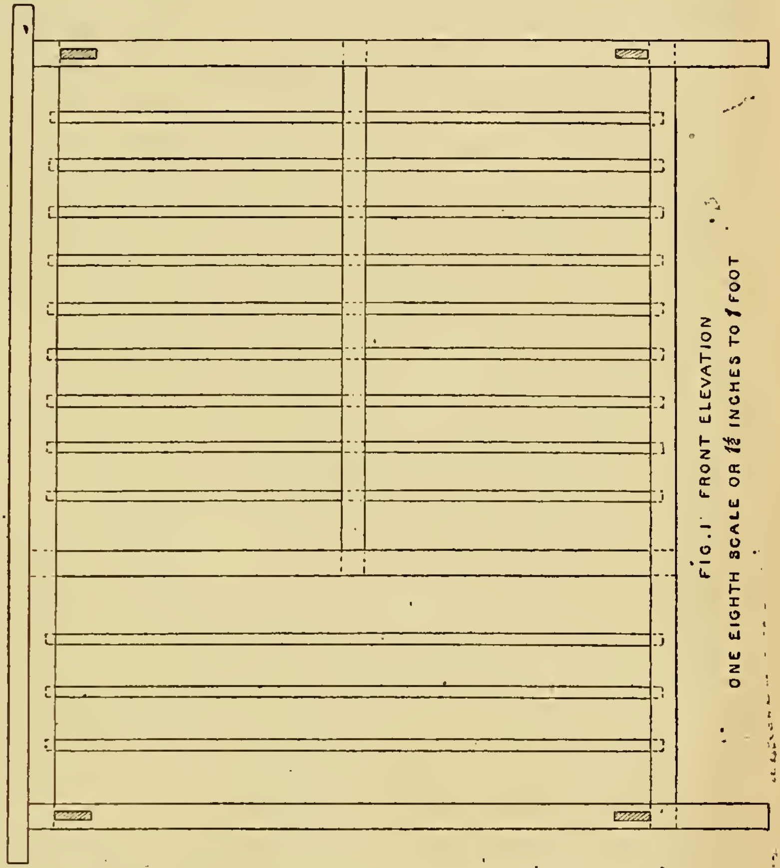
[*From* HIPPOCRATES.]

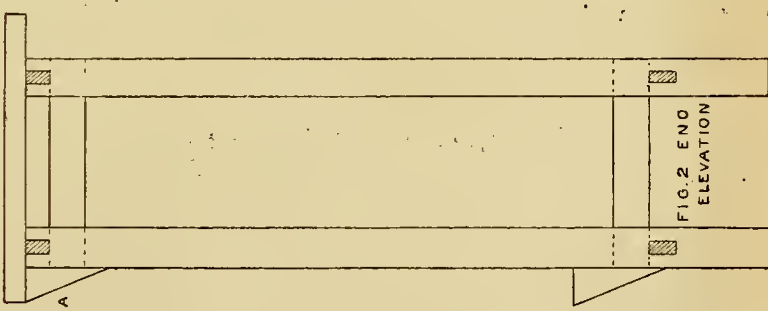
LET me begin by saying that I have taken in AMATEUR WORK from the commencement, and still I have not hitherto troubled you with any communication, and I hope you will not vote me a bore for not continuing my silence. I have received many valuable hints from ours, and spent many pleasant evenings making various things described in it, each of which when finished has proved "a thing of beauty and a joy for ever." I wish in



TROUSERS STRETCHER, FRONT VIEW.

return to describe how I made my "Literary Machine." This machine has been a great boon to me, for as I read a great deal and frequently have large and heavy books to deal with, I find it very tiring to the arms to hold them for hours in my hands, and I have to give it up, and so don't get so much reading done as I otherwise would. If I put the book on the table whilst reading, the position I have to take up, bending over the table, I find by no means so conducive to health or comfort as sitting back in an easy-chair, which I can do whilst reading with the aid of my "Literary Machine," I will first describe the metal parts. P, Fig. 1, is a 6 inch piece of ¼ inch iron gaspiping (*i.e.*, ¼ inch internal diameter); T and T′ are what are known as T-pieces, and may be purchased at any ironmonger's or gasfitter's. The short stem of these should be ¼ inch internal diameter to screw on to the ends of





the piping P, and the cross-piece should be ½ inch internal diameter. In each of these T-pieces a hole should be drilled and tapped to receive the milled-headed screws S S′. The part X, Fig. 1, I have shown enlarged in Fig. 2. It is made out of a piece of iron ½ inch thick by 3 inches by 2¼ inches, cut and filed to shape shown. To this the arm A, Fig. 1, is attached by a rivet, just sufficient play being

allowed for the alarm to swing freely. With this rivet as centre a semicircle is drawn, and on this semicircle holes are drilled about ¼ inch or less apart, also a hole to correspond in the arm A. A pin is attached to a small chain C, which is fastened to the arm A. This pin may be passed through any desired hole in X, and through the hole in A, so as to give A any suitable inclination. A short piece of ½ inch round iron is reduced at one end and screwed into a hole drilled in the centre of the bottom of X, this fits into the T-piece T'. A similar arrangement shown in Fig. 3 is used to attach the easel part W to the arm A. This piece need not be more than ¼ inch thick, and about 3 inches by 2 inches filed round at one end, as at Q, Fig. 3, and bent to a right angle about ¾ inch from the other end, as at R, Fig. 3; it is riveted to the arm A, and is drilled and provided with pin and chain similarly to the attachment at the lower end of the arm. Also two or three holes are drilled and countersunk for screws to attach it to the wooden easel W. The easel may be made out of a piece of mahogany or oak about ½ inch thick, planed and polished, and little brass clips to hold down the leaves of books must be screwed into the edge of the little shelf (see Fig. 1). These clips may be purchased for 3d., or may be made from brass wire. The table top should be made of wood to match, either mahogany or oak about ½ inch or ⅝ inch thick. This should be about 12 inches in diameter. I turned mine on a little 2½ inch centre lathe (Britannia Company's make). Some of my brother amateurs will doubtless wonder how I managed to turn a disc 12 inches diameter on a 2½ inch centre lathe. I simply turned the headstock round so that the mandrel nose projected beyond the end of the bed, fastened the wood to face-plate and got a boy to treadle (in the opposite direction to the usual one), and going round to the back of the lathe, and resting the tool on a temporary rest, viz., a piece of wood, of suitable height, turned the table-top without any difficulty. In the centre of the table-top and on the under side is secured a small plate of iron ½ inch thick and 2 inches by 2 inches. A ½ inch hole is drilled in the centre of this, and also four holes near the corners drilled and countersunk for screws to attach plate to table-top. Next take a coach-screw 6 inches long and ½ inch in diameter, cut the square head off this, and cut a thread on this end for about ½ inch. The hole in the centre of the iron plate is tapped to fit this. Pass the bolt thus formed through the T-piece T, and screw it into the top of the pedestal (see Fig. 1). The pedestal may be turned from a piece of mahogany or oak, and polished. I made mine of beech, and painted it green and bronzed it to match the iron legs beneath, which I treated in same manner. These three legs I had forged out of 1 inch by ⅜ inch iron. They cost me 1s. 10d. They are attached by screws to a round iron plate (Z, Fig. 1), which in its turn is screwed to bottom of pedestal. An iron washer should be interposed between the pedestal and the T-piece T. The screw in this T-piece may be dispensed with, the arm being prevented from rotating by screwing the table-top down tightly into the T-piece.

[In answer to the question you append to your paper, I may say by all means send other wrinkles from time to time; they will, no doubt, be well worth having.—ED.]

XVIII.—A HANDY MITRE PLANER.

[*From DUDLEY HILL.*]

SEEING that many of my brother amateurs are enquiring about mitre planers, and picture-frame making, I herewith enclose a rough sketch of a mitre planer made by me some time ago.

For picture-frame making or shooting across the ends of boards it is simply perfect. It is made of American birch, and is 3 feet long. It will accommodate moulding 2½ inches thick by 6 inches broad, or shoot the ends of 11 inch boards. It requires to be fixed upright, as seen in the sketch, in front of the bench or table. When I have mine in use I cramp the end C in my bench-vice, and the protruding end of the bolt passing through B, rests on the top of my bench. The machine, briefly described, is made of seven pieces of birch; A I call the backboard: it is 1 inch thick, 16 inches broad, and 3 feet long; B, C, and D are 2 inches by 2½ inches and 15 inches long, their respective positions may be seen in the sketch; E is 6 inches broad, 3 feet long; F is 4 inches broad and also 3 feet long; G is a short block bolted to the backboard to adjust the mitre stop D. The plane is an ordinary "Jack," with grooves cut in the sides to match the grooves cut in the inner sides of A and E. The plane-iron must be ground square across. I need scarcely add that the top edges of A and E must be shot true, and all the grooves must be truly parallel. As to the mode of using the planer little instruction is required. The plane-iron must be sharp, and set fine; the plane is then run in the grooves, the moulding placed on the mitre-stop, and pressed up to the sole of the plane, two or three cuts across should be sufficient. The batten B must be cut off below the stretcher F, or it will be in the way of the moulding. Should you publish this I will gladly answer any questions respecting the use or construction of the machine.

XIX.—TROUSERS STRETCHER.

[*From EDWARDUS.*]

HAVING seen in Vol. III. of this Magazine a sketch and description of the Trousers Stretcher, I send the following, which I have recently designed for a friend of mine, and hope my brother readers will think it an improvement on the design to which I allude.

Trousers Stretchers are now so well-known that a short description will be sufficient. A is the top, and must be about 18 inches in length, and is to be firmly mortised on to B; B, C, and D are 2 feet 6 inches long, C and D being mortised to E. B must also be tongued on both sides, and C and D are grooved in order that B may slide up and down like an ordinary book-slide. E is the bottom, and is 12 inches long. A piece of wood must be cut the exact size of A (but it need not be so thick, ½ inch will be quite sufficient, but it must be tough and strong), and screwed down by thumb-screws to A, represented by dots G, H, in the drawing. The same must be done at the bottom E. These, of course, form the clamps or vices for holding the top and bottom of the trousers. F is a small piece of wood fastened to the end of B, the two ends of F sliding up and down C and D. A hole must be bored in each end of F, and holes must also be bored in C and D, so that a wooden peg can be put through one of the holes in F,

and so held at any desired place. F must, of course, be placed at the back, and not the same side as the trousers are, for they would then be in the way of placing the peg in the holes. If the holes in C and D are placed too close to each other it will, of course, weaken them. Therefore I would recommend that the holes in C should not be parallel with those in D, so that the peg can be placed through F, alternately in C and D; it is then possible to adjust the stretchers to almost $\frac{1}{16}$ of an inch, while the holes in C or D are $\frac{1}{4}$ of an inch apart. The wood for the stretchers ought to be nearly 1 inch thick. If A and E and the two pieces which are screwed down to them are lined with soft leather or cloth, it will, of course, be better for the trousers. The two ends of A and E can also be rounded off, it will give a more finished appearance to them. To use the stretchers, fold the trousers up neatly, put the top in at A, and screw down tightly; put the bottom (of the legs, of course) in at E, and screw down; now push F up till they are stretched tight enough, and shove a peg through whichever hole F happens to be over, and there you are.

XX.—A USEFUL PLATE-RACK.

[*From THOMAS J. WHITE.*]

I HAVE just completed a plate-rack, and thinking that some of the readers of AMATEUR WORK might like to do the same, I send drawings of the front elevation (Fig. 1), and end elevation (Fig. 2). They are so simple that I think no detailed instructions, given at considerable length, are required; I may say, however, that the frame is made from wood, 1½ inches by 1 inch, and that the vertical round bars or rails are ½ inch in diameter. The top is a board 36 inches long, 12 inches wide, and 1 inch thick. The triangular blocks A, A, which are fastened to the back, are intended to keep the face of the rack square or perpendicular when fastened up to the wall. The drawings clearly exhibit the mode of construction and the method to be followed in joining the different parts together.

NOTES ON NOVELTIES.

By THE EDITOR.

29. OLD FRIENDS WITH NEW FACES. 30. HENRY'S SASH LINE FASTENER. 31. BRITANNIA COMPANY'S TOOLS FOR TURNERS. 32. ZILLES' A 1 DESIGNS FOR FRETWORK, CARVING, ETC. 33. PRICE'S "CHEZ LUI." 34. MONTGOMERIE'S "TAM O'SHANTER" HONES.

29. OLD FRIENDS WITH NEW FACES.—Let me crave the patience of my readers for a few moments while I notice a curious proceeding in trade which has recently been brought under my cognizance, but which I think it is desirable to allude to, just so far as this can be done without exposing the Publishers and myself to a chance of an action for libel, for, unhappily in these days, a man may be pilloried in a court of law for merely stating the truth. In times gone by we were taught that it was the right thing to "tell the truth and shame the devil," but in these days of wholesale moral poisoning it seems that it is considered more desirable to mask the truth and let the Father of Lies have full swing. It is held to be lawful in fact for a man in the exercise of his business to hoodwink the public to any extent that he pleases, insomuch that any one who becomes aware of the hoodwinking that is being practised, is muzzled by law and forbidden to expose it lest, forsooth, the exposure should tend to the injury of the man's business. Now the simple facts of the case that has elicited the foregoing remarks are just these. I was asked the other day to test and report on something which I will call an Article of Commerce No. 1, and which purported to be something entirely new and original, that would compete favourably with another and similar article of commerce already in the market. I thought, as any one else might, that everything was perfectly fair, square, and above-board, and that I had got hold of something that was a useful and genuine novelty. By the merest accident, however, I discovered that the two Dromios of Commerce, for the articles had a most twin-like resemblance, were actually and positively one and the same thing, and that the only difference that could be found between them was in their names only. Under these circumstances I have returned the samples, and declined to notice Article of Commerce No. 2 in any way in this Magazine. What advantage can possibly accrue to the manufacturers in having one and the same article offered for sale under two different names as two distinct and different things, I am at a loss to imagine, but that is their business and not mine. The sale of the article will not be increased by this mode of procedure, and it is certain that heated partisans and admirers will be presently condemning the same thing to the lowest depths under one name and extolling it to the utmost heights under the other. For my part, I do not see that it is in any way to the interest of buyers that one and the same article should be offered to them under two different names, and hence my resolve to refuse to notice it in any way in this Magazine, except under the name by which it was originally offered to the public, and by which it is still advertised and sold. In saying this I have said all that I possibly can say on the subject. I would be more explicit if I could, but I cannot for the reasons already stated above.

30. *Henry's Sash Line Fastener.*—Colonel R. Henry, 35, *Stanhope Gardens, London, S.W.*, to whom ironmongers, etc., should make application for wholesale prices, sends me a specimen of a new Sash Line Fastener that he has recently patented and introduced, and which bids fair to be, as he himself puts it in his letter to me, with respect to his clever invention, "a great saving of expense and worry to householders." All amateurs who have taken in hand the job of replacing broken sash lines know what a fidgety work it is, involving first of all the removal of the beading on the side of the window frame where the sash is broken; then the lifting out of the sash; thirdly, the removal of the parting beading frame between top and bottom sash; fourthly, taking out the pocket; and, fifthly, all the subsequent proceedings connected with the attachment of the new line to weight and sash and the restoration of pocket-sash and beads to the positions that they previously occupied.

Colonel Henry's invention, however, does away with very much of this work, and reduces the time to be spent over the operation to a minimum of a few minutes. His fasteners can be easily fitted into the existing grooves of every window, and do away with the necessity of taking out the sash frame or beadings to re-cord, they enabling any handy person to replace broken cords without the aid of a carpenter. Like most good and useful inventions and appliances it is eminently simple. The Fastener itself is shown in perspective view in Fig. 1, and a front view of it is given in Fig. 2. From these illustrations it is at once apparent that it consists of a brass plate with a flange at each side, forming with the plate a groove into which the sash line is dropped, and a continuation of the plate at the top, bent at right angles to it, and pierced with holes, countersunk for screws, by which it is secured to the sash frame. Fig. 2 shows how the end of the sash line is gripped and held by screws, which work in projections in the inner side of each flange. A sash line thus secured will bear an immense strain upon it. As many amateurs may wish to fit their windows with these sashes I will give Colonel Henry's directions for their use, merely introducing such slight verbal alterations as may be necessary to adapt them to the illustrations given. He says:—Take the sash frames out in the usual way by removing beading, and nip off the old sash line, taking out all nails. Fit the patent fastener, as shown in Fig. 1, to the existing slot in frame, deepening and widening the slot to any extent that may be necessary to insure its reception. Care, also, must be taken to keep the fastener in centre of the sash bar. Make a groove in the top of sash frame to allow the flat top of the fastener to drop in flush with the surface. When accurately fitted put a round-headed screw into the slot of frame through the fork of fastener, about midway, and turn the screw down until the head nearly touches the fork. The fork itself, and the position of the screw, is shown at C in Fig. 2. Now take the fastener out, and place one end of the new sash line in the lower end of fastener, as shown in Fig. 2. A few turns of the three screws will now hold the rope or line quite firmly, and the fastener can now be screwed down to the top of the frame by screws through the holes A and B, as $1\frac{1}{2}$ inch screw being used at A, and a shorter one at B, but care must be taken in each case that the point of the screw does not reach the glass, as the pressure of the screw would break it. Before screwing down take care to see that the prongs of the fork slip easily under the screw that is inserted at C in Fig. 2. The screw holes A, B, in Fig. 1, should be made a tight fit for the screws, or rather screws should be previously selected that will fit fairly tight into the holes. The screws should on no account be hammered, but carefully driven home with the screw-driver. A little tallow on the screws before insertion will greatly facilitate their removal when necessary. The object of the single screw passing through the forked end of the fastener is to counteract the strain on the lower end of the fastener, and keep it firmly in position. The sash frame should now be put back in its proper position, the other end of the rope passed over the pulley, and fastened to the weight in the usual way. Before replacing the beading take with chisel or plane as much off one side of the pocket piece as is overlapped by the beading. This done, the pocket piece can be taken out as often as required without disturbing the beading, which can now be permanently fixed in its place. Should the pocket piece be loose in fit, one small screw at the top will hold it firmly.

Fig. 1. Fig. 2.
HENRY'S PATENT SASH LINE FASTENER.
Fig. 1. Perspective View.
Fig. 2. Front View.

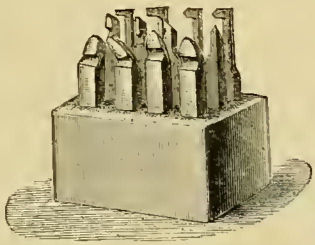
When a rope or sash-line breaks where these fasteners are used, it is only necessary to unscrew the top screws, take out the fastener, put in a new line, slip the fastener down the slot again, and screw it down to the sash bar. Neither sash nor beading need ever be moved again. As most persons will now be able to put in new sash-lines without the aid of a carpenter, a considerable saving will be effected, as the price of a new sash-line is only 2d.

The price of Colonel Henry's sash-line fasteners is 1s. 6d. each. I should recommend persons who wish to adopt them throughout the house to write to the colonel himself, and purchase them at wholesale prices. The fasteners are $8\frac{3}{4}$ inches long and $\frac{5}{8}$ inch wide, and are made of brass. I venture to suggest to Colonel Henry, that in order to bring about their general use, he should have them made in a cheaper material as well as in brass. For example, if made in galvanized iron they would be equally effective, and could be sold at a much lower rate. As it is, the cost of fitting a window with two sashes with the patent fasteners would be 6s. at retail price, and 18s. in the case of a bay window with six sashes. *Ceteris paribus*, it is easier and better for the manufacturer to sell a hundred articles at the lower price and in the cheaper material, than ten at the higher price and in the most costly material, and Colonel Henry's profits—and he richly deserves to profit by his invention—will, I think, be greatly augmented.

31. *Britannia Company's New Slide Rest Tool for Lathes.*—Many of my readers who are interested in turning will be pleased to hear of the new tools for turners which have been recently introduced by the Britannia Company, *Colchester*, and which are illustrated in Fig. 3. In tools for lathes there are an endless variety, and the amateur who is seeking to provide himself with those that are likely to be most efficient for his purpose and most generally useful, is often puzzled which to select. The engravings, however, show a selection of the best patterns, and will be useful in guiding him in his choice.

Firstly, as to tools adapted for the slide rest, and numbered in the illustrations 4 to 22, it will be useful to point out what each of them is, and for what purpose it is adapted. No. 4 is a tool for hollowing out curves and radius. Nos. 5 to 11, inclusive, are tools for general turning in metal, and the turner will see at a glance which tool is the best suited for the work that he has in hand. The shapes of the individual tools need no further remark or explana-

tion. No. 12 is called a spring tool, and is used for giving a good finish to wrought iron or steel articles. Nos. 13 and 14 are for cutting screws' internal threads. No. 15 is a tool for general turning and sliding: it is concave on its upper surface, and the sides are kept as sharp as the point. It is very effective as a parting tool. No. 16 is for boring. Nos. 17 and 18 are called heel tools, and are used for surfacing. No. 19 is for screw-cutting, cutting a V thread on a screw. No. 20 is a swivel tool-holder for general work: it will hold tools of various forms suitable for work, and these can be fixed at any desired angle. Prices: $\frac{3}{8}$ inch, 7s. 6d.; $\frac{1}{2}$ inch, 8s. 6d.; $\frac{5}{8}$ inch, 9s. 6d.; $\frac{3}{4}$ inch, 11s. Cutters for these holders are supplied at 6d. each. Nos. 21 and 22 are boring bars to hold various tools. Prices: $\frac{3}{8}$ inch, 2s. 6d.; $\frac{1}{2}$ inch, 3s.; $\frac{5}{8}$ inch, 4s.; $\frac{3}{4}$ inch, 5s. The above are made of special tool steel of uniform quality, and are the best that can be produced. It is convenient to keep the tools in a wood box or block, with the points uppermost, so that the proper tool may be picked up at once, and without the loss of time that is generally occasioned when you have to overhaul them in a drawer. The tools are shown arranged in their blocks at A and B. The prices of the metal turning tools range from 1s. upwards. At C is shown a dozen handy varieties of hand tools for wood turning, of patterns that are most generally useful. These are best kept in a frame, as shown, and fixed in a convenient position; but where a large variety of tools is kept, they are placed in a case, so as to exclude dust. I believe I am right in stating that the Britannia Company are always ready and willing to send out any assortment of tools, or of other chucks and appliances for the lathe; and I am perfectly sure that everything sent out by the Company, be it what it may, is the best possible as regards both material and workmanship.



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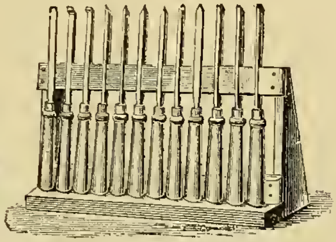

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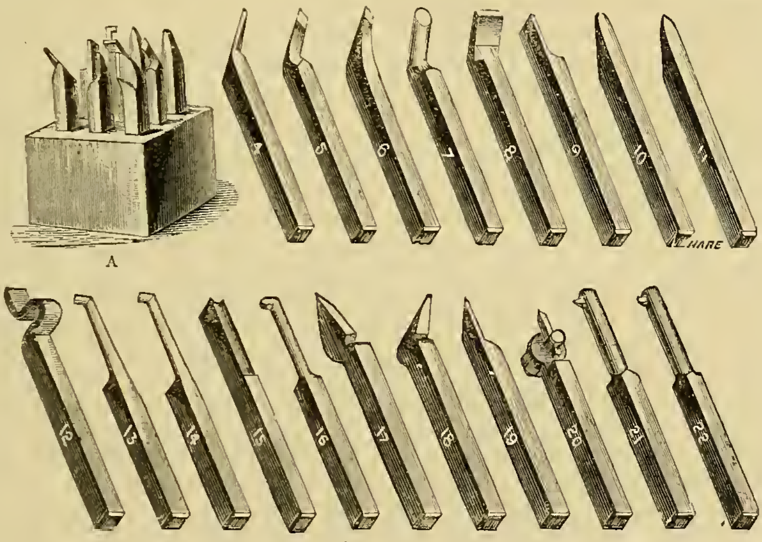


A

FIG. 3.—BRITANNIA COMPANY'S NEW SLIDE-REST TOOLS FOR LATHES.

32. *Zilles' A 1 Designs for Fretwork, Carving, etc.*—Mr. Henry Zilles, 14, *South Street, Finsbury, E.C.*, has sent me specimen sheets of his New "A 1 Designs" for Fretwork, Carving, Inlaying, and Turning—twenty-five in all—and I can only say that they are quite worthy of the distinctive name they bear. The list of designs, which is not yet printed, and of which Mr. Zilles possesses no miniatures at present, comprises clock cases, photo frames, banners for cartes-de-visite, caskets, whatnots, watch pockets, brackets, frames for mirrors or portraits, cigar stands, a revival cabinet, silk winder, cruet stand, easel, jewel box, writing desk and cabinet combined, a doll's kitchen, tool cabinet, chandelier, door plate, two alphabets, and many other articles, which I cannot find space to state individually. The price of the A 1 Designs is 8d. per sheet, or 6s. per dozen, assorted. Mr. Zilles tells me that he has only a limited number of them at present, and that those who wish to secure them should order them at once. I have also received his New List of Designs, No. 25, containing a catalogue of nearly 750 different articles of all kinds—the price of these being 4d. per number sheet, or 3s. per dozen, assorted, postage being as per list No. 24. The sizes of the various articles comprised in this list are given in inches.

33. *Price's "Chez Lui."* — This preparation, whose name possesses a special significance to the amateur, inasmuch as it is implied thereby that it is made expressly for his use at his own home, is a hard-drying enamel, furnishing a hard, smooth, and glossy surface to any kind of metal, wood, slate, stone, glass, leather, etc., is applicable to a large variety of decorative purposes although it was at first introduced as a material for enamelling and japanning the inner surface of cast-iron and metal baths without removing them from the houses in which they might happen to be, or the positions they might occupy; and therefore without stoving—that is to say, without subjecting them to the action and influence of heat during the process of japanning. In appearance it very much resembles paint, and indeed might be easily mistaken for it: the difference, however, between "Chez Lui" and paint is soon detected when they are used together and placed in contrast and comparison; for when both are dry, the former will present

a surface as smooth and as glossy almost as porcelain, while that of ordinary paint, even at its best, is somewhat rough to the touch. "Chez Lui," moreover, resists the action of hot water, and is not in any way affected by it; whereas paint, when frequently covered with hot water, will become soft, and appear to be sticky when touched. From time to time questions have been asked and desires expressed for a composition suitable for coating baths and metal receptacles for water without the assistance of heat, and for painting the exterior of model engines, etc.; and "Chez Lui," as far as I can judge, without the test of time and use wherewith to ascertain its durability, is just the preparation that is wanted for these purposes. It is sold in all colours—white, cream, flesh colour, sea-green, etc., for baths; and red, brown, blue, yellow, black, green, etc., for furniture or hardware; and any special tints to match existing work can be supplied to order. It is also made transparent, to show through it the original colour of polished surfaces of steel, silver, copper, brass or gold, and will be found invaluable for preventing rust and obviating the necessity of constantly polishing. On this account it is desirable for enamelling the bright and plated parts of bedsteads, tricycles, bicycles, and all kinds of machines, and may therefore be recommended to the attention of wheelmen. It is supplied in self-opening cans, of different sizes, at the following prices :—

	s.	*d.*
No. 1. Small sample can for enamelling small articles, or repairs and touching up	1	0
,, 2. Larger sample, sufficient to enamel a bicycle or tricycle, two coats	1	6
,, 3. Half pint, enough to give two coats to full-sized plunge-bath	4	6
,, 4. One pint, enough to give four coats to full-sized plunge-bath	8	0

Sizes Nos. 1, 2, and 3 are each sent free by post for 3d. extra, and No. 4 for 6d. extra. A brush suitable for small work and touching up is supplied for 2d., and a large brush, suitable for baths and large work, for 1s.

If found to be too thick, and in a condition that it does not work readily, it may be mixed with a little turpentine to thin it, but no oil may be added. One, two, three, or even four coatings may be given, according to the degree of finish required; but twelve hours at least must be allowed to elapse between each coating. Metal articles, and, indeed, articles of every description and material, should be perfectly clean and free from grease, rust, or any loose matter, before any attempt is made to lay on the first coat. I must not omit to say that Price's "Chez Lui" may be obtained at the prices above named, from Messrs. Ewart and Son, Bath Makers and Japanners, 346, *Euston Road*, *London*, *N.W.*

34. *Montgomerie's "Tam O'Shanter" Hones.*—Amateurs are often very much exercised about the merits of hones and whetstones, and are frequently puzzled to decide, when stones of various appearance and qualities and different names are brought before them, each claiming to be superior in every respect to all the rest. I am inclined to think, however, that they may save themselves any trouble in this respect by making application direct to the maker and proprietor of the "Tam O'Shanter," "Dalmore," and "Montgomerie" stones, Mr. John C. Montgomerie, *Hone Works*, *Dalmore*, *Stair*, *Ayrshire*, or to any ironmonger, of any of whom these stones should now be obtainable. To enable me to test the quality of these stones as thoroughly as possible, Mr. Montgomerie has sent me specimens of each kind, including the now almost disused "Water of Ayr" Stone, which is certainly far inferior to the other stones in quality, and which, according to Mr. Montgomerie, is, on account of its inferiority, entirely out of the market for polishing purposes. The stones are used by a great number of trades for polishing, in the form of blocks, slips, wheels, and discs of all sizes; the "Water of Ayr Stone," "Snake Stone," and "Scotch Stone," for the coarser purposes, and the "Tam O'Shanter," "Dalmeny," and "Montgomerie" Stones, for the finer purposes, and for sharpening edge tools of every description, with which wood-working amateurs will be most interested. Having made trial of the "Tam O'Shanter," more especially for sharpening edge tools, I find that a keener edge is produced in far less time than by the hone which I have been in the habit of using for chisels and plane-irons, which is a thoroughly good one, though at first I did not find the tools to bite very readily on it. Of course, I have not been able to test the stones as much as I could wish, nor as often as I hope to do during the next six or eight months; but I have had sufficient experience to make me resolved to use them for the future in preference to any other. There is considerable difference in the texture, if I may use the term, or grain of the different stones; those for razors, penknives, chisels, medical instruments, plane-irons, etc., being finer, and those for hedge-knives, axes, sheep-shears, etc., being much coarser, and therefore better suited for rougher implements. In writing for any of these hones, it is necessary to mention the purpose for which they may be required, and then a stone of the necessary quality will be sent. The prices of hones for sharpening edge tools, such as saws, knives, etc., vary from 1s. to 1s. 6d., uncased; but, if mounted in cases, hones for penknives range from 1s. 4d. to 2s.; for razors, from 1s. 8d. to 7s. 6d.; and for joiners' tools, from 1s. 8d. to 2s. 9d. If sent by parcel post, 3d. extra must be added to these prices for all stones except those for joiners, which cost 6d. extra by this mode of conveyance. Wheel stones are also supplied for grinding, sharpening, and polishing; but I do not know the prices of these. The hones in cases are beautifully got up; the case of hones for penknives, etc., being of white wood, well made and varnished, and having on them views of Alloway Kirk, and Burns' Monument, and the Brig o' Doon, Ayr, after the manner of Tunbridge ware. No oil is used in sharpening with these stones: the only lubricant that it is necessary to use is water, or saliva, consequently, however much a stone may be used, it will never get into that messy, sticky state which is inseparable from the use of oil. Carvers will please note that these stones may be procured in slips for sharpening carving tools, and, indeed, for all kinds of tools that cannot be sharpened on the ordinary hones.

I have other articles on my table awaiting notice, but as my space is exhausted, I must postpone descriptions of them until next month.

AMATEURS IN COUNCIL.

*** *For Instructions to Correspondents, see page 44 of this Volume.*

General Home and Colonial Agency.

** If this meets the eye of the gentleman who established the "General Home and Colonial Agency," at 54, *Rowena Crescent, London, S.W.* in May, 1884, and who subsequently disposed of it on leaving London to take up an appointment n he country, he is requested to send his present address to the EDITOR; and if any reader of this Magazine is in possession of the address that is required, he will greatly oblige the EDITOR by forwarding it without delay.

Practical Scene-Painting for Amateurs.

** The Author of the articles on scene-painting having received numerous enquiries from readers of this magazine and personal friends respecting designs and special subjects, begs to say that, not having time to prepare such himself, he has made arrangements with another artist, who will furnish designs suitable for "cloths" or perspective drawings of "set scenes," both interior and exterior, side wings, borders, ground rows, and set pieces, at very moderate charges, which may be learnt on application. Set scenes of any description or for any piece, and box chamber scenes, can also be designed in separate parts at a moderate price; also stage models, etc., etc. These designs are splendidly *coloured in distemper* on cardboard, and can be made to scale. A fortnight's notice will be required for the preparation of all designs, and they may be hired for one month at half-price; but the full amount must in all cases be deposited when ordering. Applications to be sent to the Editor, enclosed in blank stamped envelope, to be forwarded, and marked "Scene-Painting" in lower left hand corner.

Printing and Bookbinding.

CAW-CAW.—The papers on printing entitled "Printing for Amateurs," appeared in Parts 13, 15, 18, 22, 28, 30, 34, and 35; and "Bookbinding for Amateurs," in Parts 6, 8, 10, 12, 16, 18, and 21.

Violet Stain for Wood.

MAD JACK sends the following recipe for a violet stain for wood:—Take four ounces of Brazil, and one of indigo; infuse them together in a quart of water, then boil your wood in it.

Garden Wheelbarrow.

E. H. (*Shrewsbury*).—The writer of the series of papers on making a Berceannette Perambulator promised to contribute an article on this subject. He has not done so, and the subject will now be taken up by another writer. Meanwhile, you will find instructions sufficient for your purpose in Part VIII. of "Every Man His Own Mechanic," which you can obtain or 6d. through any bookseller.

Canoe Building.

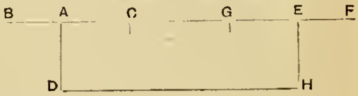
A. H. M. (*Newtownards*).—In reply to your inquiries on this subject, perhaps the best way will be to deal with each point singly, which I have much pleasure in doing:—1. A double canoe is not like a twin ship; it is in all respects like an ordinary canoe, except that it is built of sufficient length to carry two persons. 2. Midships is a point at equal distances between the bow and stern-posts. A canoe should be built to certain lines drawn to scale, and not formed, as n the instance given, of bending a visiting-card longways by so doing the bow and stern must assume a certain form. A canoe s usually built of five or six planks each side of the keel; the plank nearest the keel when fitted will be found somewhat of the shape shown in the annexed diagram. 3. Under the rules of the Royal Canoe Club a cruising canoe is not to exceed 30 inches in beam. The depth varies in different canoes, and in different parts of each canoe; the depth of the Nautilus canoe is about 11 inches at midships (without including keel), but towards the bow gets as much as 12½ inches deep. 4. As said before, it is usual to build a canoe of five or six streaks each side; but, with paper or birch bark, perhaps as few as three could be used each side. 5. The paper (or roofing cardboard) was nailed, the nails ⅜ inch long, copper, passing through the overlapping edges of the two pieces of card and wooden stringer, and clenched inside. 6. Boat builder's varnish, or the very best copal, should be used—inferior varnishes are worse than useless. 7. It is better to fit all joints so

WINDING OF BOARD.

accurately that the wood swelling when immersed will prevent leaking at joints; but, if some material must be used, equal parts of white and red lead, thinned with varnish or boiled oil, are better than most things. 8. Ribs should be about every six inches apart, and the stringers should be placed at each joint between the streaks, to nail the streaks on to; the dimensions of the stringer are about ¼ by ½ inch or ⅜ by ⅝ inch. 9. The position of masts and size of sails entirely depend upon fancy of owner and dimension and stability of canoe; but it is usual to have two balance lugs fore and aft, the fore, or mainsail, being about three or four times the size of the aft, or mizzen, sail. 10. Decked canoes are almost always propelled with a double-bladed paddle, not a single one. 11. A good length for a double canoe is 16 feet 4 inches, with a 30 inch beam; for a single canoe, this length can be reduced one-sixth, the beam not being altered. 12. For amateur canoe builders about the best works are: Mr. Baden Powell's articles in *The Field*, for January 31st and February 14th, 1880, but they may be out of print; if so, they will be found, embodied with much more invaluable information, in a large book, "Yacht and oat Sailing," by Dixon Kemp, published by *The Field* Office; "Practical Boat Building for Amateurs," published by *The Bazaar* Office, *Strand*; for sails, etc., "Practical Canoeing," by Tipleys, published by Noril and Wilson, 156, *Minories, E.C.*, at 5s.—R. C. C.

Hanging Cabinet.

S. M. L. (*Goderich, Canada*).—In the design for this cabinet (Vol. V., page 29), there are *six* carved ends, instead of *four*, as you seem to think, and this has led to the supposition on your part that "the artist or engraver seems to have placed the carved lower end (with flutes) of the right side *underneath* the body of cabinet, instead of under the lattice work. The following diagram will help you. Three terminals in the form of quarter circles form the orna-



SKETCH PLAN OF HANGING CABINET.

mental bracket-like finish to the cabinet on each side, proceeding on the left from the point A to the points B, C, D; and on the right from the point E to the points F, G, H. The fact is, that the quadrants from A to C, and from E to F, do not appear in the drawing, as they are, in point of fact, hidden by those that do appear. If the quarter circles from A to D and E O H were omitted, much of the beauty of the cabinet would be lost, and the projecting body of the cabinet would be without the apparent support that s given to it by these parts.

Glazing Textile Fabrics.

H. D. (*Cambridge*).—The glaze or gloss on textile fabrics is produced by friction and pressure combined. It is unlikely you could use the glazing-iron to advantage before seeing it used by someone who is expert at the work; and this you must do. Glazing, as I have said, is produced by combined rubbing and pressure; there is, in fact, a knack in it which it would be difficult, if not impossible, to describe in words. Calendering, or "cylindering," of which the former word is a corruption, is done by passing the fabric to be glazed between hot rollers; but chintz curtains, etc., are glazed by rubbing the surface with a heavy polished substance, the curtains being laid on a flat surface, such as a large wooden table.

Magic Lantern Slides.

J. B.—I have a paper in hand on the preparation of magic lantern slides, which will appear in due course.

Publishers of Fret-Work Designs.

SCOTUS.—The only publishers of fret-work designs, "other than those who advertise in AMATEUR WORK," that I am acquainted with are Messrs. Bemrose and Sons, *Old Bailey, London, E.C.*

Launch Engine Boiler.

H. H. D. B.—Sheet iron $\frac{1}{16}$ in. thick is out of the question. The shell should not be less than $\frac{3}{16}$ in., or, better still, ¼ in. thick. Unless you are acquainted with boiler making, and fully alive to the importance of this class of work, I must strongly advise you to draw the line at it, and especially at 60 lbs. pressure. If you can obtain the services of an experienced hand, or possess a knowledge of the craft, then I shall be most happy to give you the assistance you require as to design, etc.—CHEZ LUI.

Electric Motor.

E. L. (*Esholt*).—Mr. Edwinson never forgets his promises. He sincerely regrets that the many calls on his time and energy have prevented him from writing as much as he could wish for AMATEUR WORK during the last few months; but, like most of us, he hopes for the coming of better times, which in his case means a little more leisure to follow his own inclinations.

Cutting and Polishing Pebbles.

MODUS.—The article on "Cutting and Polishing Pebbles," at page 505 in No. 46 of AMATEUR WORK, appears to answer the whole of the questions asked. Devonshire Madrepores are generally rather soft, and can be beautifully polished with a small amount of labour. For simply polishing the face of a stone, hand rubbing on a slab of common stone, such as doorsteps and sinks are made of, and which can be had at any stonemason's, will give the level surface, which can be finished with putty powder, as fully described in the article above referred to. For the harder stones—agates, etc.—machinery is almost a necessity, as hand labour would be too hard work; but the process is fully described in the same article. The prices of the articles required are given in the same place, as supplied by the Leicester Utility Company. Half-a-pound of each would be enough to start with.

IGNORAMUS will find all the questions he asks fully answered in Part 46, September, 1885, of AMATEUR WORK, except cost of arming slitting disc with diamond dust. This would be probably about 5s.—W.E.H.

Photographic Studio Fittings.

J. Y. (*Uxbridge*).—Mr. C. C. Vevers will deal with studio fittings and backgrounds in his papers on "Dry Plate Photography" now appearing in the Magazine. With regard to painting backgrounds, if this be out of Mr. Vevers' line, Mr. Benwell will give the necessary instructions at some future time.

Price's "Chez Lui."

F. J. C. writes:—"Referring to a reply to C. R. G. in 'Amateurs in Council,' Part 52, page 236, rejapanning bath, allow me to call your attention to 'Chez Lui,' a 'hard drying enamel,' supplied expressly for this purpose by Ewart and Son. I have not actually tested this preparation myself, but as far as I can judge from some samples I have seen coated with it, it is an excellent substitute for japan, and is not a quarter the trouble. As regards the cost, I believe it is very cheap, a shilling sample tin being sufficient for a *small* bath. It is also applicable to leather, glass, wood, and cardboard, as well as to tin or iron, and this is another advantage, as it can be used on various articles which could not be japanned in the ordinary way, as they would not stand heat. As I am sure this article is just what we amateurs are often wanting, would you kindly find a small corner in 'Notes on Novelties' for a report on it. Messrs. Ewart and Son would, I am certain, be very glad to forward samples, etc., for your inspection, and if it is 'as good as it is painted!' it will supply a long felt want. It is obtainable in any colour, and I believe can be had to match any particular tint required. If so ordered, C.R.G. might find this the very thing he wants as the usual mode of japanning is, I think, far beyond an amateur's means, more particularly the 'stoving.' I may add that 'Chez Lui' dries hard in a few hours without 'STOVING' at all." [I am obliged to you for calling my attention to "Chez Lui," which I had never seen or heard of until a few days before the date of your letter, when by mere chance I happened to see it in a shop close to the Mansion House Station, in Cannon Street. A specimen is now in my possession for testing.—ED.]

UNCLE TOM'S CABIN.—Thank you for your letter. You will have seen that attention has been already drawn to this useful composition by myself in "Notes on Novelties," and various correspondents in "Amateurs in Council." Your remarks that you "have just done over some old tea trays with it, and that they look quite as good as new," and that you "find that the thinner the coats are applied the better," will give useful hints to many readers who wish to do a little japanning at home without stoving.

Scene-Painting—Paper Scenery.

PLANE-IRON writes:—"The admirable articles on Scene-Painting which have lately appeared in our Magazine have, I am sure, been read with great interest by many subscribers who, like myself, take an interest in this sort of thing. If you could find room, and your correspondent would kindly write a few papers on Stage Carpentry and the fitting up of the framework and grooves to carry the wings, flats, etc., it would be a great boon to many of your readers. With regard to the paper scenery mentioned in the articles, I would caution your readers against purchasing without seeing what they are buying. Some friends of mine purchased the so-called 'garden scene,' for which they paid 40s. The scene arrived, and when unpacked presented to view a number of sheets of greenery, designated foliage, and a few sheets, I think four, on which were very roughly printed a very badly drawn representation of a bay with a mountain in the distance, and in the foreground the two pillars only of the balustrade shown in the sketch. The sheets were mounted by a professional paperhanger according to the instructions given, and the effect was that of a small picture set in a deep green frame. Through being badly printed every joint showed up distinctly, and the general effect when hung up and the footlights lit, was ludicrous in the extreme. To designate the unmeaning mass of greenery 'foliage,' or to call the whole thing 'scenery,' is an insult to one's common sense. The scene, however, had to be used, and the only way to make it presentable was to call in a scene painter, and go over it with distemper, enlarging the centre picture, and painting out one half of the so-called foliage. This was done, and the effect when used as a back cloth, and with a set scene in front, was fairly good. 'Once bitten twice shy,' however, is a motto that will hold good in their case, for it will be a long time before they again throw away 40s. on rubbish that would be dear at forty pence." [Mr. Benwell intends to follow his papers on "Practical Scene-Painting for Amateurs," with instructions on Stage Carpentry.—ED.]

Brass Casting.

BRASS MOULDER.—Mr. F. J. Durrance's papers entitled "Brass Casting at Home," which appeared in Parts 14, 16, 20, and 23 of this Magazine, will give you the information you require. If, however, there is any part of the process that you do not precisely understand, write again stating your difficulty, and Mr. Durrance will reply.

Terrestrial and Water Telescopes, etc.

E. N. D. (*Cardigan*).—See reply given on this subject to J. L. D. (*New Quay*), page 286. An inquiry for a recipe for shoemaker's wax has been made by J. L. D. (*New Quay*), and inserted in page 288. Lastly, I am waiting for a paper on making a banjo, promised long ago by JACK HORNER. If Jack Horner is too busily engaged in pulling other plums out of the world's pie, I wish he would tell me so, as I have another contributor ready and willing to write on the subject. I keep to the "first-come-first-serve" principle as long as I can, but my patience, as well as that of my readers, is often sorely taxed.

Overmantel Glass.

D. R. (*Plymouth*).—Your request for an overmantel to match the Hanging Cabinet described in Vol. I., page 24, has been referred to Mr. Adamson, who will not fail, I think, to supply the design you wish for.

Zoetrope, etc.

JOB.—I am glad to be in a position to reward your patience at last by saying that I have a paper in hand on the Zoetrope and scientific toy of this class, which will appear later in the year.

Revolving Stereoscope.

TYRO.—I agree with you that instructions for making a revolving stereoscope would be acceptable to many readers, and I suppose from your letter, although you do not absolutely say so, that you are prepared to write such a paper. If so, write to me stating your name and address, which you do not give.

Blacking Coil Bobbins.

NEW READER.—(1) Paint them with a good vegetable black colour ground in varnish, or with best black sealing wax varnish. (2) Get some ebony stain—frequently advertised in this paper—stain the bobbins black, and polish as herein directed. (3) Boil the bobbins in strong liquor of logwood chips, dry; soak for half an hour in vinegar containing two drams each of sulphate of iron and sulphate of copper. Wash in potash water; dry. Then put on spindle of lathe, and wipe with a rag smeared with white wax. Heat the bobbin by friction to drive the wax well into the wood, and so get a good polish. Either of those methods will give them a glossy black appearance. When you write again please give name or initials. We have many "new readers."—G. E.

Regulator for Coil.

New Reader.—There is really little or no difficulty in building a coil to work without a separate regulator or break. In the sketch sent by you the core is composed of a bundle of iron wires. These are left sticking out at one end of the coil, and this projection forms the magnet to work the brake. The whole core is magnetised, and therefore the projecting part has its share. The brass tube regulator is made to slide over the core inside the primary coil. To alter your coil, you must either put in a new core with a projecting end, or drill a hole in the old core half way through, and fit a piece of soft iron tightly into the core. This should be in the form of a nail with a thick, broad head. Please excuse delay in reply. I have been very ill since the receipt of your letter, and even now have not recovered my normal strength.—G. E.

New Fret Saw Machine.

D. H. writes:—"I forward particulars of a remarkably good new fret machine which is worth knowing about. I have one, and I expect they will be exhibited in the forthcoming exhibition. The saw requires no fixing nor adjusting. It is a most powerful cutting machine, and the bearings novel, with minimum friction, and a *quiet* machine." The machine to which D. H. refers, according to the printed prospectus that accompanies his letter, is Alcock and Co.'s Simplex Fret Saw Machine (Jackson's patent), manufactured by Messrs. Alcock and Co., 132, *Russell Street, Melbourne*, and sold in two forms, namely, on stand with fly wheel and crank complete, at £2 10s.; and on pillars, ready for fixing on sewing machine or lathe, at £1 10s. It is claimed for this machine that labour is economised and friction minimised, that it is possessed of great durability and quick cutting power, and that the saws can be changed in a moment, and require no fixing. As far as I can judge from the engravings that appear in the prospectus, the stand, from its construction, is perfectly rigid, the machine has a double treadle, which is obviously an advantage in keeping the machine running; the arms proceed from bars inserted in sockets that are attached to the upper and under surface of the table, and when connected by the saw form a framework, that is apparently depressed by a cam or eccentric below, and carried upwards by the action of a spring. The engravings, which are not printed as clearly as they might be, do not exhibit the details very distinctly, and I may be mistaken in the working of the machine. If I am, perhaps D. H., who has one in his possession, will set me right. I can only say that I like the look of the machine very much: its construction is simple, and if the saw arms could be obtained in this country, any amateur with a slight knowledge of carpentry could make the stand for himself.

Shocking Battery.

H. H. P.—From the tone of your letter, it would appear that you do not understand how galvanic shocks are sent through the body, since you ask for a battery to give continuous shocks. Know then, if you please, that galvanic batteries do not give continuous shocks. Shocks are got from instruments known by the name of induction coils, and an article on the construction of these instruments appeared in Amateur Work a short time since. The special kind to give shocks as a remedial agent for disease, is known as medical coils, and I hope ere long to describe such an instrument. Batteries are to coils what a steam boiler is to a steam engine. If you wish to get any work out of your battery or boiler, you must have an engine. Kindly read my recently published paper on "Induction Coils," and inquire again if you do not understand how to get the effects desired by you. At the same time, please tell me exactly what you want to do.—G. E.

Reversing Horizontal Model Engine.

Model Engine asks if he can reverse his "horizontal model engine with one eccentric by means of screw or lever, and without altering present position of crank, and so as to allow the shortening of slide while running, if possible." To this my reply must be that I do not know of any way in which the object desired could be effected, but of course another eccentric and links could be easily added, or a loose eccentric might be substituted in the usual manner.—J. P.

Printing for Amateurs, etc.

New Subscriber.—Two papers on making telephones appeared in Parts 8 and 11 of this Magazine. With reference to "Printing for Amateurs," see reply to Caw-Caw, page 331 of this volume.

Crewe's System of Glazing.

G. D. (*Northampton.*) — Crewe's Improved System of Glazing is protected by Letters Patent. The number of the patent is 11960, and the date Sep. 3, 1884. Any communication addressed to Mr. H. T. Crewe, 17, *Sunning Hill Road, Lewisham, London, S.E.*, or to the West Kent Horticultural Works, Messrs. Couchman and Company, *Montpelier Vale, Blackheath, S.E.*, will receive prompt attention.

Trousers' Stretcher.

Bags will find information on the mode of making Trousers' Stretcher in Parts 30 (Vol. III., page 344) and 43 (Vol. IV., page 398) of this Magazine.

Messrs. Skinner and Co.'s Specialities.

Printer writes:—"I was pleased to see in your last issue the lengthy notice of Messrs. Skinner and Co.'s productions, for such notices as these help amateurs in their selection of machinery and goods much more than the mere perusal of various catalogues. For the benefit of my brother amateurs I should like to state that I have used Messrs. Skinner and Co.'s fretwoods for some time past, and I find them the best prepared and cheapest of any I have used. The fact is, this firm has been in the timber trade for many years, and this experience is of great importance in the selection of logs specially suited for cutting into such thin stuff as fretwood; being direct importers also, their prices as well as quality naturally compare very favourably with those of other firms. I consider their three-ply *very cheap*, as work executed with it is much stronger and proves more satisfactory than when executed in ordinary wood. Messrs. Skinner and Co. have always shown a courteous interest whenever I have communicated with them, and my brother amateurs will do well to write for list. Apropos of Scotus' remarks, I note that Messrs. Skinner and Co.'s new patterns are neatly printed in chocolate ink."

Brass Sheathing for Organ Treadles.

H. W. (*Whitchurch*).—Stout sheet brass suitable for covering the footboards of organ treadles could probably be obtained through any respectable ironmonger. If you find any difficulty, write to Messrs. Ponders and Baker, General Metal Merchants, 47 to 51, *Featherstone Street, Finsbury, London, E.C.* This firm supplies metal work of all descriptions at very reasonable rates. Tell them what you require, and I have no doubt you will get it. —M. W.

American Organ Bellows.

Reed Pipe.—American organ bellows are made with rubber cloth ribs, which appears to be the best material for the purpose. They might be made with wood ribs and soft leather joints, the same as in pipe organ bellows, but I do not think they would be found so satisfactory.—M. W.

Discoloured Varnish on Globes.

Tyro.—The discoloured varnish on your globes can be removed by a careful washing with high proof spirit of wine. Apply it with a broad camel-hair pencil. Repeated applications of the spirit will doubtless be needed. On no account be tempted to use water or any alkaline fluid. After the varnish has been entirely removed, you will doubtless wish to re-varnish your globes, but ere doing this you must give them a coating of parchment, isinglass, or other clear size, or your new varnish may penetrate the weak places, and utterly disfigure your work. We advise you to wait a short time. Articles are in the hands of the Editor, and will appear in due course, on the "Colouring, Mounting, Varnishing, and Repairing of Globes and Maps." These will enable you to renovate your globes, so as to make them appear almost equal to new.—B.

Lamp for Boiler.

S. M. L. (*Goderich, Canada*).—The shape and height of your lamp will depend upon the room at your disposal. If you wish the lamp to be covered by the boiler, I would recommend it—the lamp—to be made about 6 inches long by 4 inches wide, and say 2½ or 3 inches deep. The deeper the better, as it will then not require replenishing so often. The sort of lamp you want is identical with those fitted to heating and cooking stoves, and should have at least three wicks each 5 inches wide, the burner being similar to an ordinary petroleum lamp. You must provide means of regulating the supply of air, as on this depends the efficiency of the burners. A chimney should be fitted and three sides of the lamp-room closed, but the fourth—opposite end to chimney—provided with the means of regulating the draught. If you can manage it, the cold air on entering should be prevented, as far as possible, from striking against the boiler.—Chez Lui.

Paper Rosettes.

F. P. (*Andover*).—Messrs. Bemrose and Sons, *Old Bailey, E.C.*, publish a work on paper rosettes and the method of making them, and supply paper rosettes for ornamental work.

Relacquering Cornice for Bay Window.

J. H. S. (*Manchester*).—The cornice to which you allude is, I presume, made of brass. If so, it is unlikely that you will make a good job of relacquering it, as the soiled and stained surface must first be removed, and you will not have the appliances wherewith to do this. The cornice must first be put into a bath of aqua fortis diluted with water, and allowed to remain there until it has become clean and bright. It must then be rinsed in clean cold water, and dried in hot saw-dust. Then the lacquer, which is intended to preserve the brightness which has been obtained by the action of the acid, may be applied. There are various lacquers for brass, but a pale gold lacquer may be made by dissolving ¼ oz. of red sanders, and 5 ozs. of crushed seed lac in 2 quarts of methylated spirits of wine. The lacquer must be strained before using it.

Removal of Broken Pieces of Screws, Studs, etc.

Adam Bede writes:—"Try first the common plan of a cape or narrow chisel applied to edge of screw. Failing that, and where practicable, cut a draft and apply a screw-driver. Lastly, adopt the common resource of boring it out, but sharpen and work the drill *the reverse way*. By this plan it will almost always be found that the screw will be quickly *screwed out* by the action of the drill. The greater the pressure on the drill, the more certain is the result. The drill should be about one-fourth less than size of screw."

Construction of Electro Motor.

R. S. writes:—"I should like to say that from the very full and clear directions given in Amateur Work I have constructed an electro motor for revolving vacuum tubes, which works capitally with one bichromate cell. I am very much pleased with it."

Japanese Gold Paper.

A Subscriber from the First.—The Japanese gold leather papers may be obtained of Messrs. C. Hindley and Sons, *Oxford Street, W.* On page 218 of Amateur Work, Vol. III., is a list, with prices and numbers of the leading designs. They run in all gold, the cheapest and yet most effective, from 2s. the square yard. The more costly patterns have the design picked out in coloured bronzes. Messrs. Rottmann Strome and Co., of *St. Mary Axe*, have a large variety, but only sell wholesale or in large quantities. They run from 15s. to 63s. the piece of 12 yards; 36 inches wide. —J. W. G. W.

Simple and Effective Drill.

R. A. W. (*Dublin*) writes:—"In the illustration on page 288 the spindle of the drill appears to taper; this is not so in fact. It must be the same diameter throughout, or the handle would not slide properly. I daresay my drawing is the cause of the mistake." [What you say respecting the spindle of the drill is perfectly right, nevertheless the engraver copied your drawing faithfully.—Ed.]

How to Draw an Oval of any Required Length.

J. F. T. Bailey writes:—"In former issues plans have been given 'How to draw an oval.' The last I recollect seeing—the best I think given—introduced *string* and *pins* as aids. As all 'fret-workers,' no doubt, have noticed, in printed photograph designs, the 'ovals' are invariably out of proportion, and each has endeavoured to correct such defects. For the benefit of such, I send the plan, with diagrams on which I 'draw an oval of any required length.' Draw a straight line the *exact* length of the oval required. Divide with compasses the length into five equal parts. Describe a series of four circles within these parts, the *radius* of each being equal to the distance between any two points. The line of circumference of the top and bottom circles passes through the points A and B respectively. Those of the inner two, bisecting the diameters of those immediately above and below. Then ascertain with the compasses the one-ninth of the circumference,

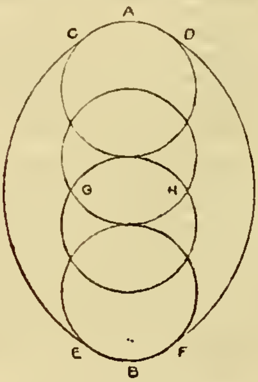


DIAGRAM SHOWING MODE OF DRAWING OVAL.

and mark points C D on top circle and E F on lower circle. Then at the points G H, where the second and third circles cut each other, extend the compasses from G to D, and connect D with F; then from H to C, and connect C with E. A little care, and a few minutes' trouble is all that is necessary to obtain an oval of *any length* by this plan." [Instead of taking the ninth part of the circumference of any one of the circles, take one-third of the arc G H, which arc is one-third of the circumference of either of the four circles drawn on the straight line A B.—Ed].

Boiler and Horse Power of Engine.

Cincinnatus.—Better try and pick up a secondhand boiler from some reliable source, or get one made by a mechanic. After consideration I think it advisable that amateurs should draw the line at boiler making on a comparatively large scale, unaided by the presence of an expert. I cannot tell you precisely what size your boiler should be. If you had given me the diameter of the cylinder, and the power you require, I could then have done so. You "guess" it to be about half-horse power; if that is near the mark, then a vertical boiler about 20 inches diameter, and 3 feet high would be suitable. Formula for horse power is as follows:—Area of piston × pressure of steam in cylinder × revolutions per minute × stroke in feet × 2 = 33,000-horse power. The pressure in the cylinder depends on the cut off, and the mean pressure throughout the stroke must be taken.—Chez Lui.

Sale and Exchange Department.

E. C. R. says that he has had about nine replies to his advertisement in our Sale and Exchange Department, and that no applicant enclosed a stamp or stamped and addressed envelope for reply. I venture to hope that all who reply to advertisements will do this, as it is not only courteous to the advertiser, but secures—or ought to secure—a reply to each letter. I may suggest that to enclose with application an addressed post-card would be a cheap, easy, and safe way of meeting the difficulty.

R. J. P.—I am sorry that you had no reply from the advertiser to whom you sent a postal order and stamp for reply. Had you given me your address as well as your name—you will remember that you had run your pen through the *printed* address on the memo. form on which you wrote—I would have sent you the name and address of the advertiser of whom you complain, and then you could have written for an explanation. I know nothing of advertisers personally, and all that I do, or undertake to do, is to insert notices and addresses, and forward replies to the name and address corresponding with the number marked on the envelope. Returning to the subject of your letter, if your reply to the advertisement of which you speak came into my hands, it was duly addressed and forwarded. It is possible, however, that the letter so addressed may not have reached the advertiser; and there is another possibility, namely, that your letter and enclosure may never have reached me.

Noisy Clock.

Clericus.—The "noisy clock" you speak of is probably caused by the counting lever coming to rest on the count wheel, and is peculiar to this type of clock. Any attempt to cure it would probably be worse than the disease. You might try the effect of slightly bending the counting lever or click, but the result would most likely be that the striking would become erratic, and liable when once started to go off "all at once," like the one-hoss shay, or a mitrailleuse. However, you might bend the point or hook of the counter forward a little, so that the deep teeth at the ends of the hours would not bear all over, and you might tighten the bearings or pivots of the spindle carrying the count lever.—Olla Podrida.

Soap Making at Home.

Clericus writes:—"I have made excellent soap, *with all the glycerine in it*, by following your directions, and using Harvey's caustic soda."

Hollowing out in Turning.

W. H. R.—In hollowing out in turning, after attaching the wood to the chuck, you must work from the centre to the circumference, as you say you do. The best tools for you as an amateur without much practice to use in turning soft wood, are the gouge and the chisel. Skilled turners use other tools called hook tools, but it requires practice to do good work with these. You will be much helped if you purchase "Turning for Amateurs," by the Rev. James Lukin, published at 2s. 6d., by L. Upcott Gill, 170, *Strand, W.C.*, and read Chapter VI. on "Tools and their Application."

Waterbury Watch.

S. W. G. (*Peckham*) writes:—"It may be of interest to intending subscribers to AMATEUR WORK and 'Waterbury Watch' combined, to know that I have had one of those watches in use for the past five months. I was persuaded by a friend to buy one, and bought it more as a curiosity than with any real hope that it would answer its advertisement, but I have been agreeably disappointed. It has kept splendid time. The cases keep their colour well, and are as good as when first bought. I am not in any way interested in the sale of the watch, but write my experience for the benefit of your readers generally."

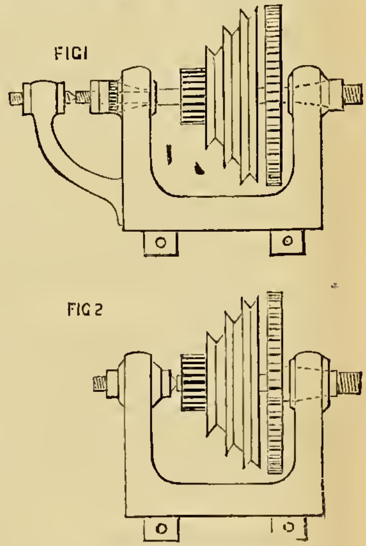
Clock Cleaning.

A. B. C. writes:—"With your permission and OLLA PODRIDA's, I would like to afford a few hints on Clock Cleaning that would be supplementary to his articles on this subject in AMATEUR WORK, not that I could give better or clearer instructions, but that I think a few general hints on the escapement of the timepiece would greatly help those who will have a trial at their timekeepers; and also because I find so many clocks with the same complaint. Before proceeding further, I may explain that I am a *professional* clockmaker. I suppose I must call myself so, seeing that it is my trade; but at the same time I have no wish to push myself before, or to make myself objectionable to OLLA PODRIDA, and if you think I am out of order, please drop it in the waste-paper basket; but I have learned so many things from your book, and am so thankful, that I would like to do a little in return. At the same time, I would like to tender my thanks to Professor Marissiaux for the description of the 'Cabaret Battery' for the electric clock, as I intend making one for myself forthwith, and if any other reader cannot get the wheels, I will do so for them. I have enclosed my name and address, and if you will kindly supply any inquirers, I will do my best, and now to business. In the first place, before putting the spindle in socket of the wheel that carries the hour hand, put a little oil on the two bright parts where the wheel works, one of which is close to end where the minute hand goes, the other close down to wheel, as the spindle works inside it, and therefore wants oil. And to put the stop work of the alarm train on right, wind the spring quite up, then let it run till the key (which you can leave on) has gone round half a turn, then put the finger piece on the square, with the finger in the last notch of the star wheel, which is fixed to the plate always, and see that you cannot wind it up any more, as then there is no fear of over-winding and breaking the spring. The best thing I find to put the spindles in their holes is to use a pair of long nose pliers or very stout tweezers, either of which can be got at Morris Cohen's, whose address, by the way, is 132, *Kirkgate, Leeds*, not 'Kingsgate.' And now for the escapement. On taking off the pallets, you will generally find deep notches worn by the action of the escape wheel, and if so, an easy way to cure this is to put a small collar or washer on the pin under the pallets, so as to raise them high enough from the plate for the escape wheel to work on the good part. Do not file the marks out, as you will very likely alter the shape, and then they will be useless. It is much better and easier to shift them by a collar, if the pin should not be long enough to allow the turn buckle, that keeps the pallets from falling off, to rest on the end. After putting a collar on, pull it out and put a needle in and break it off at a length suitable; if after you have got this all right you find the escape wheel tooth falls farther on to the pallet that is bent round nearly like the letter C, as in annexed diagram, slightly raise the arm that the pallets are on till the drop on both pallets are equal. It can be easily raised or lowered as the case may be, as it is riveted to plate, and left sufficiently loose to be moved with a pair of pliers. Also look at the pendulum rod just where the loop of the wire that is fixed to the pallets embraces it, and also at the inside of the loop, and you will generally find a notch worn each side of the rod, and the loop as well sometimes. If the loop is worn much cut it off (after first noticing how it is bent, or bend a piece of spare wire up to match) then straighten out the rest, and file it down a little smaller, and nicely burnish it, and bend up a fresh loop. It will make it a little smaller, but that will not affect the timekeeping of it, but if the loop is not worn much, it may be filed out by using a narrow file that will go in the loop, afterwards using a knitting needle or bodkin for a burnisher. Then serve the rod the same. You will then have to close the loop a little, otherwise there will be too much play for the rod in it; and, lastly, be sure to put a drop of oil in the loop to prevent further wear. Hoping these few lines will help any that find any difficulty in making their clocks go after following OLLA PODRIDA's instructions, if I can help anyone at any time I shall be only too pleased to do so. I only wish I could express myself better on paper, I then would have offered my services to our Editor long ago, as I have often thought there would be many glad of a little help in doctoring their own clocks. In conclusion, I would strongly recommend and advise the use of Ezra Kelley's clock oil, as I find that is the best I have used; and as I have the cleaning and repairing of some hundreds of clocks and watches every year, I can speak from experience." [Every reader of AMATEUR WORK who is interested in Clock Cleaning and Repairing, to say nothing of OLLA PODRIDA and myself, is obliged to you for sending the above remarks. Had you written and offered your services some time ago, I should have been most ready to accept them, and OLLA PODRIDA would have been saved the trouble of working up the subject in the interest of those who wished for instruction on clock cleaning. I shall gladly avail myself of your aid in future, for you write clearly enough, and to the point. Readers who wish to avail themselves of A. B. C.'s offer to supply them with wheels for electric clock making must send application under cover to me in sealed and stamped envelope marked "Clock Cleaning—A. B. C." in lower left hand corner, and I will then address the letter and have it posted.—ED.]

PALLETS FOR CLOCK.

Headstocks for Lathe.

H. H. D. B.—Of the two forms shown in your sketches which are reproduced here, that readers generally may understand my



HEADSTOCKS FOR LATHE.

reply to your query. No. 1 is much the best for heavy work, the mandrel being better supported at the tail or back end. Gunmetal is best and cheapest for the bushes, being more readily fitted and safer in inexperienced hands. Very few lathes are now made with hardened steel bushes. The gunmetal should be of a hard mixture. —OLLA PODRIDA.

INFORMATION SUPPLIED.

Fasteners for Boot Buttons.

CLERICUS writes in reply to COBBLER (page 192):—"I found some very good 'button fasteners' at a little cobbler's shop near Pall Mall—'Repairs while you wait.' A small metallic attachment with three points is passed through the leather,

and clenched with a suitable pair of pliers. I ave seen two other kinds, but this is, I think, the lightest and best. But I do not know where they cau be bought, and Pall Mall is a 'far cry' to Yorkshire. They are, however, just the thing for those who lack a needle and nimble fingers." [Would Clericus be kind enough to try to give the exact address of the tradesman of whom he purchased the fasteners. One might hunt about the neighbourhood of Pall Mall for hours without finding the shop in question, but Clericus, who has been there, could, no doubt, find it again without difficulty.—Ed.]

Electric Clock.

O. B. (*Jersey*) writes in reply to C. C. F., page 192:—"The wheels and pinions required for the electric clock would very likely be obtained of Mr. Morris Cohen, 132, *Kirkgate, Leeds*, mentioned by Olla Podrida in his article on "Clock Cleaning and Repairing," page 228. Please note that it is *Kirkgate, Leeds*, not *Kingsgate*, as there printed."

Watchmaker's Tools.

F. Y. G. writes that F. A. E. (*Bailieboro*) "Will do well if he sends a stamp to Mr. Cohen, Watch and Clock Tool-maker, 132, *Kirkgate, Leeds*, for his new illustrated price-list of watch and clockmaker's tools and materials."

O. B. (*Jersey*) writes in reply to F. A. E. page 192:—"The watchmaking tools required may be obtained of Mr. Morris Cohsn, 132, *Kirkgate, Leeds*, where also one may obtain small screws and bolts for model engine fitting, turning tools, drills, files, drill chucks, and many handy little things required by amateurs. There is also a Mr. Clegg, 18, *Belinda Street, Hunslet, Leeds*, who advertises in the 'English Mechanic' for wheel-cutting in brass up to 12 inches diameter."

Stadt Dresden writes in reply to F.A.E. (*Bailieboro*):—"Morris Cohen, 132, *Kirkgate, Leeds*, keeps all kinds of watchmaker's tools. He also makes screws and bolts for models. G. A. F. (*Folkestone*) and C. C. F. could obtain clock wheels from him. If either of these querists has a vertical milling slide attachable to the slide-rest, it would be easy for them to cut the wheels themselves."

Varnish for Patterns.

Stadt Dresden writes in reply to H. J.:—"Pattern-makers generally use shellac varnish, which is common shellac dissolved in naphtha, or in methylated spirit of 90°. If, however, the pattern is large, or is to be coloured, nothing equals good copal varnish, provided, of course, the pattern is not going to the foundry in less than a week."

F. Y. G. writes in reply to H. T.:—"The following varnish was patented some time since in Germany, and is claimed by the patentee 'to dry as soon as put on.' It is said 'to impart to the pattern a smooth surface,' thereby insuring clean castings, and 'to prevent the wood from warping, shrinking, or swelling, and is impervious to moisture.' The ingredients—$\frac{3}{4}$ lb. of shellac, $\frac{1}{4}$ lb. of manilla copal, $\frac{1}{4}$ lb. of Zanzibar copal—are placed in a vessel which is to be heated and stirred during from four to six hours, after which six parts of 'finest potato spirit' are added and heated to 87° C. for four hours."

Collection of Foreign Woods.

Pitchpine writes:—"I think Nameless will be able to get just what he wants of Mr. Wilmersdorffer, 72, *Finsbury Pavement, E.C.* His 'album of veneers' contains a collection of forty of the most important woods, each one being cut in three different ways. The price of the album, including an inlaid wood cover, is 25s., carriage paid. It is a highly interesting work, and is largely sold for microscopic purposes, and to scientific societies."

Steam Power Loom.

E. L. writes in reply to H. W. (*Exmouth*):—"With reference to your request for information on model weaving loom to go by steam, I would advise you to make a small wooden hand loom, unless you happen to be an expert mechanic. To make one to go by steam would involve some rather intricate pattern-making, and some very accurate mechanic's work. Instructions for making either hand loom or power loom would take up more room than the Editor could possibly set apart in "Amateurs in Council." The subject would have to be treated in an article in the Magazine, that is, if the Editor deemed it of sufficient general interest." [That is just the question. I fear it would not be deemed so, and I do not see myself that it would be attended with useful and practical results.—Ed.]

INFORMATION SOUGHT.

Small Chinese and Japanese Cupboards.

J. L. D. (*New Quay*) wishes for designs of small Chinese and Japanese cupboards, such as are brought home from the East by sailors.

Reading Desk.

J. L. D. (*New Quay*) wishes for a small pattern of a reading desk. [A design for a reading table or "literary machine" will shortly appear.—Ed.]

Design for American Rocking Chair.

J. B. (*Stonham*) writes:—"Will some subscriber to Amateur Work give me a design for an American rocking chair, with drawings to scale of same?"

Improved Lester Fret Machine.

Adam Bede writes:—"My improved 'Lester' breaks my saws, tilts up the work, refuses to do fine work, takes—except for comparatively straight sawing—longer time, more trouble, and greater attention than my old two and sixpenny saw bow. Is the machine at fault or am I?"

Boot Rack.

Bags wishes for a design for a boot rack. [A design of a boot and shoe rack appeared in Part 22 (Vol. II., page 513), but Bags probably wishes for a movable article of furniture, consisting of supports for boots between two standards, after the manner of a towel horse.—Ed.]

Oval Turning Lathe.

S. (*Coatbridge*) asks:—Will any reader of Amateur Work tell me how the oval turning lathe works for turning pick and hammer handles; also, the address of a good maker of the same?

Cutting Glass Bottles.

J. B. C. asks:—Can any reader of Amateur Work kindly tell me of a plan to cut in two the square-shaped Hollands bottles? I find the glass too hard for the diamond to work on.

Treadle Drilling Machine.

N. E. Signalman asks:—Will any of my brother amateurs oblige me with a good design for a small drilling machine to work by foot, and to drill from 1 inch to $\frac{3}{8}$ inch. I have made myself a pair of bevelled cog-wheels for that purpose, but I cannot conceive of a plan to make my machine for the drill to travel in its work without affecting the cog-wheels.

Zincography.

W. C. (*Dumfries*) wishes for a description of the process known as zincography, and to learn if there be any treatise through which an amateur might post himself up in the art. [Can Mr. H. W. Grantham give instructions on this subject.—Ed.]

Polishing Curling Stones.

Curler writes:—"I have a pair of curling stones which through use are getting rather dull. Can anyone inform me how I could polish them myself without going to the expense of sending them to the makers?"

Yarn Winder.

Mad Jack writes:—"Can any reader give me designs and instructions for building a yarn winder, such as is used for winding yarn into balls?"

The "Blake" Transmitter.

Binoo asks:—Can anyone describe the "Blake" transmitter, which is used by the Lancashire and Cheshire Telephone Company, and is stamped "not for sale," so I suppose an amateur would have to make on for his own use? A sketch will oblige.

☞ ADDRESS WANTED.

F. P. (*Andover*) is requested to send his Name and Address to the Editor, who has some letters to be forwarded to him.

☞ OLD TYPE.

Typo is about to send a quantity of old type to the foundry, and will let F. P. (*Andover*), or any other amateur, have some at foundry price. Applications to be sent, in a stamped envelope, marked "*Typo*" in lower left hand corner, under cover to the Editor.

COMMUNICATIONS AWAITING REPLY

Hong Kong; W. F. (*Lee*); Bougwan; Adam Bede; H. M. (*Wincanton*); Mad Jack; W. J. P.; H. P. A. (*Watford*); Ursus; E. S. D.; E. N. D. (*Cardigan*); W. T. P.; S. C. R.; J. P.; J. L. (*Weymouth*); Lindum; Stadt Dresden; S.; A Musical Reader; Lap; Tyro; C. P. W.; F. R. (*Driffield*); J. T. H; J. C. H. (*New Basford.*)

THE WIMSHURST INDUCTION MACHINE

Designed and described for

AMATEUR WORK ILLUSTRATED

by

THE REV. OLIVER BECKERLEGGE.

*** Figs. 1, 2, 3, show Side Elevation, End Elevation, and Plan of Machine, and are drawn on a Scale of 4 inches to a foot.

REFERENCES TO LETTERS IN FIGS. 1, 2, 3.—*A*, Discs; *B*, Standards; *a*, V piece taken out of head of each Standard to give facility in replacing Discs, the V piece is kept in by screws; *C*, Belt of Machine; *a*, Dowels holding Brackets; *D*, Driving Wheel; *E*, Combs; *F*, Leyden Jars and Wood Bung; *G*, Shelf carrying Jars; *H*, Handle for driving; *I* Bearing for Spindle; *J*, Neutralizing Rods; *K*, Discharging Rods; *L*, Bosses carrying Discs; *M*, Handle to move Discharging Rods; *N*, Belt.

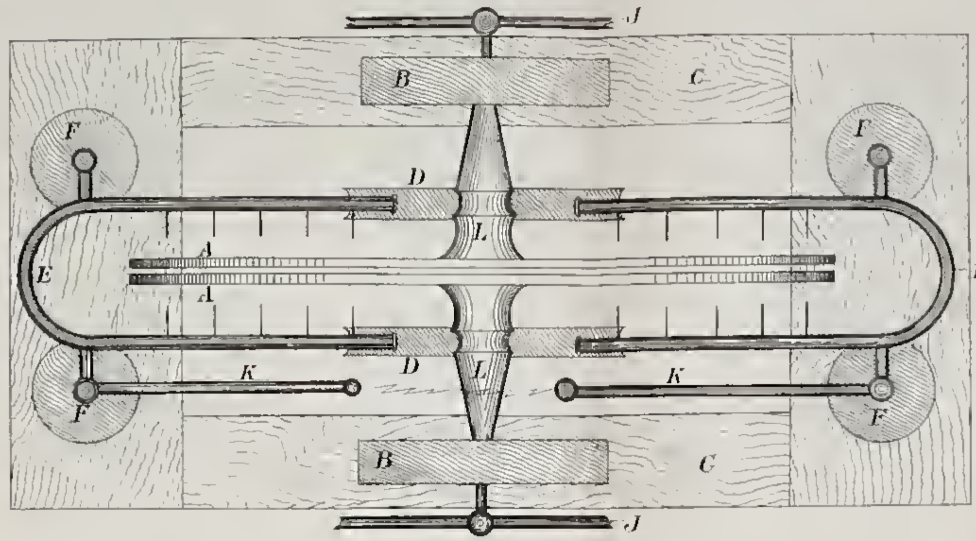


FIG. 3.—PLAN VIEWED FROM TOP.

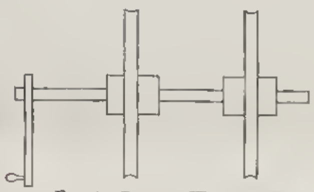


FIG. 4.—DRIVING WHEEL.

FIG. 5.—BOSS. DOTTED LINES, *a*—*a'*, SHOW BRASS BUSHES TO RUN ON SPINDLE.

FIG. 6.—MODE OF JOINING BELT.

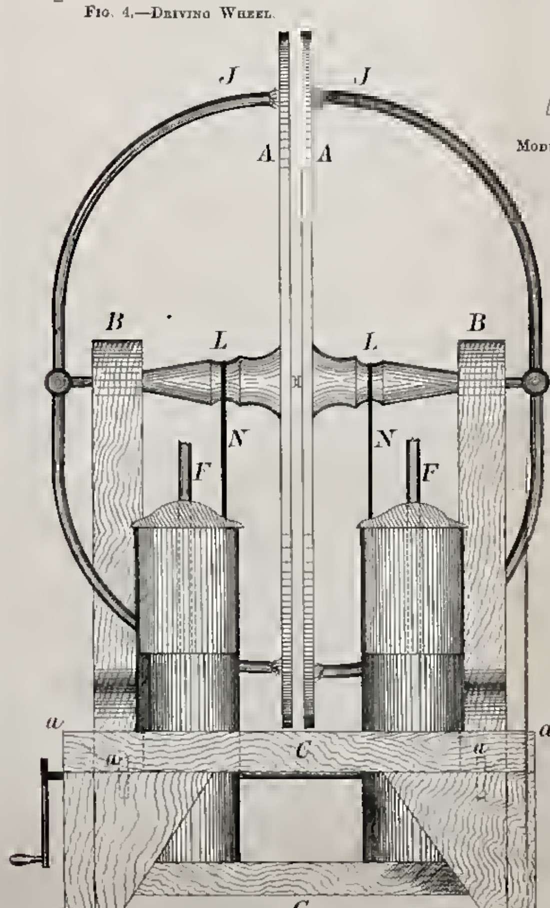


FIG. 2.—END ELEVATION.

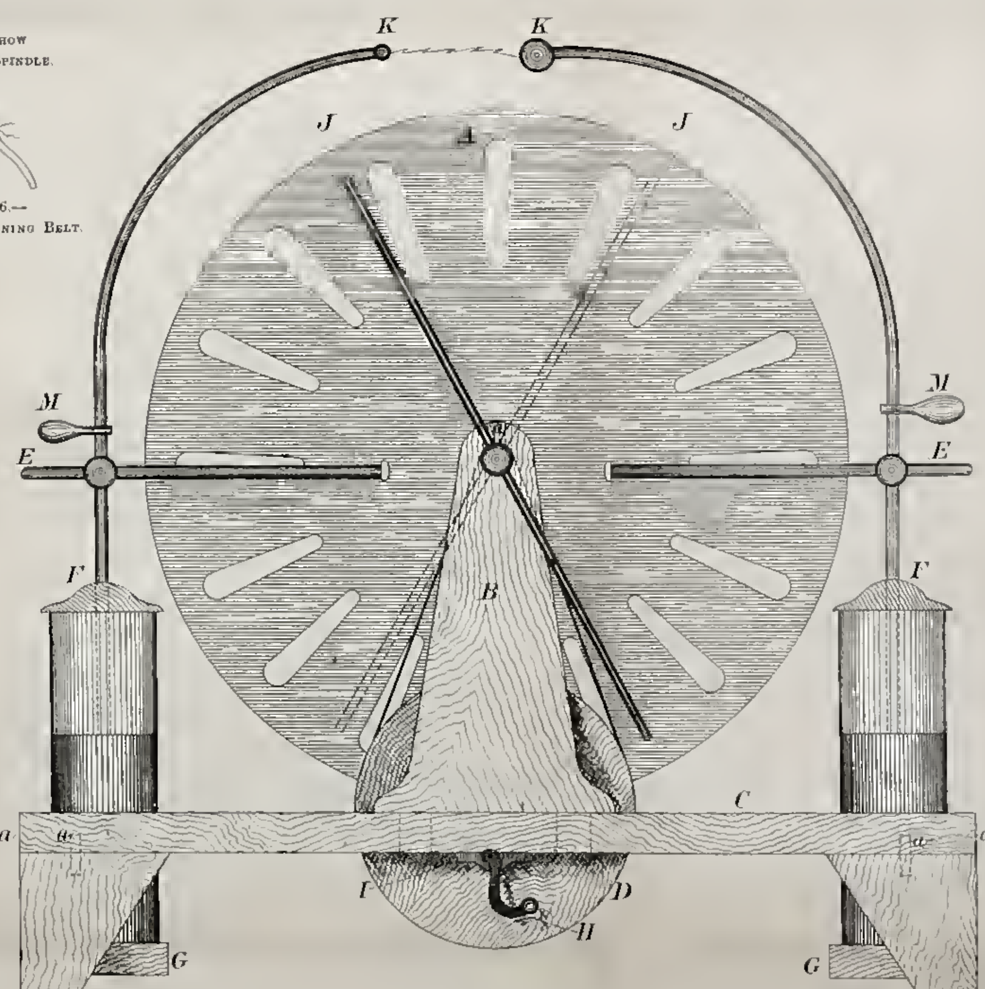


FIG. 1.—SIDE ELEVATION.

WARD, LOCK, AND CO., WARWICK HOUSE, SALISBURY SQUARE, LONDON, E.C.

COLOURING PHOTOGRAPHS FROM THE BACK.

By D. B. ADAMSON.

UNDER various names, such as Photoleum and Crystoleum painting, the art of colouring photographs from the back has during the last few years enjoyed an increasing popularity. Although hardly entitled to rank as high art work, the results obtained are very beautiful; and as little or no knowledge of painting is required, a very easy way of giving a life-like appearance to photographic portraits is at the command of everyone. By whichever name the process is known, the mode of procedure is much the same. Without going into details at present, the plan is to stick an unmounted photograph (an ordinary silver print) face downwards, *i.e.*, the picture side of the paper on a piece of glass. The paper is then rubbed away partially and made transparent, after which it is painted over on the back. The colours show through the photograph, which forms the shading, over the painting which has been laid on behind it. Special mediums for sticking, rendering transparent, etc., are usually employed, and my object is now to show how to prepare and do this work with the simplest materials and without needless trouble. Several artists' colourmen prepare special sets of materials, and, so far as I know, they are all good, but the process I now describe is simpler and more expeditious than any other with which I am acquainted, while the result is little if at all inferior to that produced by the most elaborate preparations.

FIG. 1.—PHOTOGRAPH TO BE COLOURED.

Any glass will do to stick the photograph on, but it should be free from flaws and of good colour. Special convex glasses, which are to be had from most dealers in artists' materials, at very low prices, are prepared for the purpose, and I should strongly advise them to be used. They are very thin and clear, showing up the photograph with great brilliancy. The photograph, if already mounted, must be detached from the card. This can be done by soaking it in hot water till the photograph comes off easily. The photograph is then stuck face downwards on the concave side of the glass, starch being used as the adhesive medium. The starch should be prepared in the usual way, moderately thick and free from lumps. Attention to this latter point is very essential. The photograph should be well smeared with starch before putting it on the glass, so as to render it quite pliable, otherwise it will not adapt itself to the concave surface. It must now be gently pressed on to the glass, working from the centre outwards so as to squeeze out all superfluous starch and air bubbles. Some care should be used to get rid of these, as if allowed to remain, the painting when done will have a spotty appearance, which will effectually destroy its beauty. Wooden squeezers are sold with the colourmen's sets, but they are unnecessary as fingers do equally well, or better. If the photograph is well saturated with starch, or the fingers kept moistened with it, there is little or no risk of tearing the photograph, but if any apprehension exists on this score a piece of paper between the finger and photograph will prevent any injury. The photographs being well laid, as much of the paper as possible must now be rubbed away. Glass-paper, of course, only the finest sort, is generally advocated and used, but I prefer to use the tips of my fingers instead, as the rubbing off of the paper can be proceeded with at once without waiting for it to dry. As the photograph gets drier during the rubbing, the finger will require slightly moistening occasionally, and great care will be necessary towards the end of the rubbing down process not to rub too hard, otherwise the thin photographic film may be scratched through, thus leaving an ugly mark on the finished painting. It is not requisite nor indeed advisable to rub *all* the paper away, and good effects may frequently be obtained by leaving it

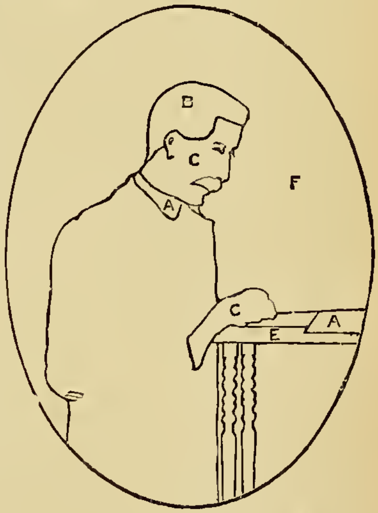


FIG. 2.—DISPOSITION OF COLOURS AT BACK.

thicker in some places than in others. It is not meant that the differences in thicknesses must be left indiscriminately in a patchy manner, but beyond this limit it is not possible to give in the present paper further instructions on this point.

As the skill of the painter increases, judgment will decide what parts may be left thick, and what must be made as thin as possible. When as much of the paper as is deemed advisable has been rubbed away, the result at first is apt to be disappointing, as though not quite opaque, the photograph (looked at from the back), or rather the paper, looks patchy and streaky, more transparent in some places than in others. In a short time the photograph will be quite dry, and the next thing to be done is to render it more transparent. I have used various mediums for this purpose, such as melted wax, paraffin, different kinds of oils and varnishes, but I find nothing better than a mixture of castor oil and turpentine, while it possesses advantages over most of the others I have tried. It is very cleanly in use, inexpensive, easily obtainable, colourless, and the painting can be proceeded with at once. About three parts castor oil and one of turpentine are good proportions, but considerable latitude seems to make very little difference. A very small quantity is sufficient for an ordinary carte-de-visite. The photograph should be completely saturated with it, and in a very short time the opacity and streakiness of the paper will entirely disappear. Superfluous oil may now be rubbed off with a soft rag, till the paper ceases to glisten. It is then ready for painting.

The brushes employed should be sable hair, of moderate size, one of them very small, for minute dots, such as the whites of the eyes, jewellery, etc. The paints used are the ordinary artists' oil colours in collapsible tubes. It is, of course, almost impossible to give a precise list of the colours, as requirements will vary according to the subject, and the skill of the painter in mixing to obtain different colours and shades, but I may name the following as generally useful in an ordinary portrait :—

White, black, cobalt, or other similar blue, vermilion, middle chrome or other bright yellow, yellow ochre, burnt umber, emerald green, and megilp as thinning medium. This list might be greatly extended, but it contains sufficient variety to paint an ordinary figure photograph, especially if it is one of a man, and has a plain background. Photographs of our rulers, the gentle sex, generally require a much more elaborate palette, and woe betide the unlucky man who presumes to paint any of the dress or trimmings in different colours from the original worn when the photograph was taken. Let him not fancy that he can improve the picture by colouring even so much as a little bit of ribbon a bright crimson when the piece was "crushed strawberry," or whatever the then fashionable hue may have been. Therefore, O Novice, attempt not the portrait of thy wife, if thou art married, nor of her whom thou fondly hopest to make thy wife, if still in the state of single blessedness, till thou hast some command over colour ; but if thou wishest to paint thy mother's portrait, thou mayest safely do so, and present it to her with the assurance that she will not too severely criticise thy work, nor condemn it with faint praise, even though thou hast painted a piece of the dear old lady's personal decoration with Prussian blue, instead of crimson lake.

A small quantity of each colour required must be pressed out of the tubes on to a palette, for which, as the work is small, a plate or tile will do very well. Before beginning the actual colouring, let me remind the learner that he has *simply to apply tints*, and that he has nothing whatever to do with painting shadows or gradations of shades, these being ready formed by the photographic film, which, when the picture is looked at from the face or glass, is over the painting. This it is that renders crystoleum so remarkably easy, as compared with ordinary painting, in which all shading has to be carefully worked. No matter how rough the paint looks behind, the colouring will show through the photograph naturally shaded, and the result will probably astonish the beginner. The colour may almost be said to be plastered on rather than painted. A reference to the accompanying cuts will make the details of manipulation perfectly apparent, I hope, to the beginner. They are from a photograph selected for its simplicity. Fig. 1 shows the portrait with its shading, and Fig. 2 the same photograph from the back—the outlines representing the different masses of colour. It will be noticed that no attention is paid to the outlines of the waistcoat or sleeve, which, being the same colour as the remainder of the coat, are blocked in with it. As the photograph supplies the shading, it follows that the tint at the back must be regulated by the highest light of any part painted in the same colour. It is, therefore, necessary to mix *largely* with white, otherwise the finished painting would be too black and dark. Beginners frequently err in using the colours too dark—seldom in mixing too much white. It is impossible in a mere written description to give the exact shade required, but a few experiments will soon show it, and I would here point out that the colouring can only be altered to a very small extent, after it has been applied, and while the paint is still wet, as it is the colour that is immediately next the photograph that shows, not any after-colouring on the back. In ordinary colouring, errors can be rectified by painting over them, but this is not the case with the crystoleum process. Care should, therefore, be used in getting the proper tint at once.

An examination of the picture, Fig. 1, will show that six different tints or colours are required as follows: 1, collar and paper; 2, hair, moustache, and eyebrows; 3, face and hands; 4, coat and waistcoat; 5, desk; 6, background.

The collar and paper (A, Fig. 2) should be painted in first, pure white, or white with the smallest possible trace of blue. The hair, eyebrows, and moustache, B, as our subject is a silvery-haired gentleman, white with black, instead of blue. For brown, light yellow, carroty—beg pardon—golden or auburn hair, various shades of brown must be used. Face and hands, C, in this instance vermilion, and a little burnt sienna, of course mixed with the indispensable white, the colour slightly deeper on the cheek, gives the flesh tint. Sallow skins require a little yellow or brown to represent them properly, but the mixing of flesh tints can only be acquired by observation and experience. It goes without saying that in likenesses more attention must be given to this than in fancy pictures. Coat and waistcoat, D, being black, must be painted with a very light grey (black and white); a touch of blue gives the effect of a blue-black. Desk, E, burnt umber. Background, F, emerald green and white, pure, or with a little of the colour used for E. This, with the dark background of many photographs, gives a fine tone of green; but if the photographic background is very light, must be considerably darker. That is all, and an hour's work will have turned the dull monochrome photograph into a beautiful life-like coloured picture.

Those who have practised crystoleum painting will notice that I have only mentioned one glass. The use of two for one painting complicates the process, and I do not think adequately compensates for the extra work and care involved, by the slight advantage that there may be in some instances from their employment.

The painting being finished, the back should be protected by a piece of cardboard cut to the size of the glass, and fixed to it by strips of gummed or glued paper. If these don't extend more than ⅛th inch on to the surface of the glass they will be hidden by the rebate of the frame in which the picture will no doubt ultimately be placed.

Photographs thus prepared, being on glass can only be hung on walls or placed about on easels, instead of in an album. It will no doubt have often occurred to crystoleum painters that an easy way of colouring photographs on the back, while allowing them to be put in an ordinary photographic album is a thing to be desired, and I have much pleasure in placing before readers of AMATEUR WORK a process by means of which this may be effected. Though practised by me many years ago, and for aught I know by others, long before crystoleum painting from its simplicity became fashionable, it will probably be novel to most amateur colourists to whom it affords an easy means of greatly improving and adding to the interest of the contents of an album, as not only the features but the complexion, colour of hair, eyes, etc., of friends can be preserved. The actual painting is exactly the same as already described, and glass is still used, but only as a temporary support, while the photograph is being made transparent and painted. Any common flat piece of glass will do, and if a little larger than the photographs, so much the better. Instead of starch, wax or paraffin should be used to cause the photograph to adhere to the glass. An easy way to do this is to warm the glass sufficiently to cause the material used to melt when rubbed against it. This will leave a slight film of the wax or paraffin on the glass, against which the photograph is pressed till it adheres, warming the glass if necessary from time to time. Care should be taken that there is not an excess of wax, or the result may be that the photograph lies lumpily on the glass, but it is not essential air bubbles should be pressed out as thoroughly as when the painting is to remain permanently on glass. Should the photograph be uneven from wax causing lumps, special precaution must be used in taking off the paper not to rub holes, as one is apt to, where the lumps are, particularly if glass-paper is used instead of the fingers. Making transparent and painting are done exactly as already described, after which the work must be put aside to dry. When the paint is perfectly hard the photograph may be taken off the glass and mounted. It will probably leave the glass easily, but should it stick too tightly, the appliance of a little heat will soften the wax or paraffin sufficiently to allow it to be stripped off without risk of tearing. A strongly adhesive medium must be used to fix the photograph to the card, otherwise it will not stick firmly. I find Le Page's carriage glue very useful for this purpose. A little wax will remain on the face of the photograph somewhat spoiling its appearance. It can either be removed by rubbing with a rag moistened with turpentine, or a high degree of polish on the photograph may be got by simply rubbing with a soft dry rag. This finish greatly improves the photograph, and gives much the appearance of the enamelled surfaces sometimes seen on photographs. I may here say that should wax be used instead of paraffin, it ought to be pure white, not yellow.

Although reference has only been made to figure painting, it must not be supposed that the same means cannot be used with landscape or other photographs. They are, however, much more intricate, and my object has rather been to show how a beginner at this work may take it up with reasonable expectations of making a fair painting than to give instructions to

those who are well advanced. I have, therefore, gone somewhat more into detail than would be necessary were I writing only for the latter, who will still, I trust, be able to gather some ideas that may assist them in colouring photographs. The following hints may be useful, and perhaps save some disappointment to the beginner. Choose a strongly printed photograph —not a faded, weak-looking one. Make some allowance for the *colour of the photograph* in deciding what paint to employ on any portion of it, as it must be remembered that the paint will be seen through the medium of the photograph and be correspondingly altered. A mixture of the colours of the paint and the photograph will so to say be formed. Take as an example light emerald green viewed through a brown-coloured photograph. The appearance will be that of neither alone, but of the two combined, or more accurately of emerald green, glazed (*i.e.*, painted with transparent colour) with brown. This makes it somewhat difficult to get natural looking hues in foliage or blue skies in landscapes, unless the photograph is printed with the sky showing perfectly white. Those who can photograph, and wish to colour their own productions, can easily do so by taking a positive on glass direct or by contact, and thus avoid the rubbing off of the paper, though painting on the gelatine film is a little more difficult than on the paper. Carbon transparencies, which have already been described in this magazine might also be used for painting on. The carbon film could no doubt be laid in the convex glasses, but as I have not tried this process, I merely throw out the hint for what it is worth to those who are better up in photography than I am.

Now a word to those who may colour photographs for the first time, and are disappointed with the result. If (mark the "if," please) you have no friend who can point out mistakes, and tell you how to avoid them in future, I shall be happy to assist you to the best of my ability, only don't imagine because unknown to you that I am therefore more competent to do so than your friend. Don't in his or her case let "Familiarity breed contempt." This is provided the Editor will kindly forward on to me any paintings he may receive for the purpose, and insert replies in "Amateurs in Council." I will take all reasonable care of any paintings sent me, and return them by post if stamped wrapper is enclosed with them, but I cannot hold myself responsible for damage or loss in transit.

[Coloured photographs for inspection and criticism must be sent under cover to the Editor, in envelope stamped, sealed down, and partly addressed to "*Mr. D. B. Adamson*," with the words "*Coloured Photograph*" in lower left-hand corner. The Editor will then complete address and forward letters.—ED.]

METAL ORGAN PIPES:

HOW TO MAKE THEM.

By MARK WICKS.

I.—PIPES OF METAL—CASTING BENCH AND CASTING BOX—METAL FOR PIPES—MELTING METAL—NECESSARY TOOLS—SCALE FOR CUTTING METAL FOR PIPES —FORMATION OF SHEET METAL INTO PIPE.

SEVERAL correspondents who are carrying into effect the instructions given by me in the preceding volumes with respect to organ-building, have pleaded hard to be supplied with information as to the construction of metal pipes. I certainly have rather deprecated amateur attempts in this branch of organ construction, for two reasons, viz. (1), because it is undoubtedly a fact that but very few amateurs possess the requisite skill; and (2), because in most cases metal pipes could be bought at a less cost—when the outlay for tools and apparatus is taken into account—than that which would be incurred by an amateur in making them for himself. But, as I have said, many amateurs have pleaded hard for instructions in the work, and say that if I will only tell them how to set about it, they are quite determined to try their hands at metal pipe making. Under these circumstances, and as it is quite true that amateurs have before now turned out very creditable work in this branch, I can no longer refuse to give a favourable answer to the appeal made to me, and will therefore endeavour to describe, in as clear and concise a form as possible, the *modus operandi*.

If amateurs intend to cast their own pipe metal, it will be necessary that they should have a proper bench for the purpose. Some manufacturers use a large slab of York stone or slate; others have a wooden bench.

As this latter form will probably be that most within the reach and requirements of the amateur, I will describe it more particularly. The top or table of the bench is formed by placing pieces of stout wood—yellow deal will do—about ⅛ inch apart, and then bolting them tightly up, but keeping them apart by pieces of thin stuff. Suppose you do not require to cast metal for pipes larger than Tenor C Open Diapason, the bench top will require to be about 5 feet long and 18 or 20 inches wide, and should be formed of deals 1½ inch thick and about 4½ inches wide, placed *edgewise*, ⅛ inch apart, and bolted up in the manner described. The planks should run lengthways of the bench. True up both top and under side of this table, and square it at each edge. The bench or table top is now to be covered with a piece of good linen bed-tick or moleskin cloth. This should be stretched tightly over the top, brought down all round, and then

securely tacked on the under side of the bench. See that this work is well done, and that the ticking or moleskin lays perfectly smooth and without wrinkles, and be careful that there are no chips between the table and the ticking, or anything that would cause the slightest deviation from a level surface. The table top should now present an appearance similar to that of an artist's canvas stretched ready to paint upon. The bench is now placed on a pair of tressels, or otherwise firmly supported, so that it lies quite level.

The casting box is a simple affair, but it must be strongly put together. Fig. 1 shows both the bench and the casting-box, and it will be seen that the latter is a square box with a sloping back, and is nearly as long as the bench is wide. It should be made of oak at least 2 inches thick, and may be 5 or 6 inches wide at the top, and about 5 inches high. It has no bottom, and the front is made to slide up and down a little way. This may be managed by cutting a tenon on each end of the front, and carefully fitting it into a groove at each end of the box. A strip of inch oak is fixed to the ends, so that it is raised about ½ an inch above the front, and a couple of fine-threaded thumb-screws, or screws with fly nuts, are then screwed through the slips into the top of the front, so that by turning them the front may be raised or lowered, so as to regulate the width of the opening marked C in Fig. 1 at the bottom, through which the metal will flow when casting. The bottom edges of the box must be planed perfectly true, so that no metal can run out except at the proper opening. A rebated runner is fixed on each end of the box, so that the rebates just fit over the edges of the bench, and allow the box to be pushed freely backwards and forwards along the top of the bench. Now screw a slip of brass along the front end of the bench, as shown at B in Fig. 1, bring the casting box close up to it, so that the brass securely closes the opening at the bottom, and with a bradawl bore a couple of holes through each runner into the bench side; about an inch will be sufficient. If a stout wire is inserted in each of these holes, the box will be kept firmly in its place, so that the metal can be poured in. The wires can be pulled out when the casting is to be made.

The next thing is to decide on the composition of the metal of which the pipes are to be made. The metal generally consists of a mixture of tin and lead. Tin is the best metal to use, as it is light, strong, durable, keeps it lustre and colour, gives a fine tone, is not much affected by changes of temperature, and does not easily corrode when it comes into contact with the rack boards or stock boards. Lead pipes, or those which contain a very large proportion of that metal, have many faults. They are very heavy, so much so that they are apt to crush up under their own weight; they oxidise easily in damp air, and at the points of contact with wood—especially with oak—forming sugar of lead, which is very poisonous; they do not keep their lustre or colour, and the tone is much less brilliant than that obtained from tin. In order to harden lead pipes, antimony is sometimes mixed with the metal, but this causes them to be brittle, so that they split when being tuned with a cone, and, in the case of inverted conical-shaped pipes, they sometimes snap right off.

For very large pipes, such as those required in the pedal organ, zinc has been used of late years with very satisfactory results. It is very light, is not much affected by a moist atmosphere, keeps well in tune, and gives a very fair tone. The speaking parts of these pipes should, however, be made of pipe metal, let into and soldered to the zinc. Zinc is very cheap, and will stand hard knocks, so that for show pipes it is very useful, but it does not give good results if used for pipes under 4 feet long.

Now, as I have said, tin is the best metal to use, but it is very expensive, so that unless for first class instruments it is not used without adding a certain proportion of lead.

The show pipes of the great organ at the Albert Hall are composed of nearly pure tin (90 per cent.); the internal pipes are five-ninths tin and four-ninths lead.

Common pipes contain 5 times as much lead as there is tin, but about the most useful proportion is two-thirds lead to one-third tin, which makes what is termed "spotted metal." These spots rise to the surface when the metal is cooling, and when the pipes are polished up they look as though they were marked all over with inkstains which have been partially cleaned off. If a little more tin is added, say 5 parts of lead to 3 parts of tin, the spots run closer together; indeed, spotted metal proclaims its quality by its appearance. If the spots are very widely separated, the quantity of tin is small, but if they are numerous and close together, the proportion of tin is large. Such pipes give good round tones, and are very satisfactory for all except stops which are required to give a piercing quality of tone, in which case the more tin there is in their composition the better.

Having decided upon the quality of our metal, we place the requisite proportions of each in an iron melting pot. The proportions are taken by weight, and as regards the lead, it may be useful if I say that the lead linings of grocer's tea-chests, being very soft metal, are very applicable for the purpose, and grocers are often glad to dispose of this stuff at a very cheap rate. Put a little Russian tallow and a small piece of resin into the melting pot, to keep the metal nice and clear, and when the metal is thoroughly melted, ladle a sufficient quantity out into an iron saucepan—which

should previously be greased and made warm—sufficient to cast a sheet of metal of the size required. The sliding front of the casting box should be raised by adjusting the screws, so that the aperture at the bottom is rather wider than the thickness of the sheet of metal to be cast. Thus, if we require a sheet $\frac{1}{16}$ inch finished thickness, we must make the aperture rather more than $\frac{1}{16}$ inch wide, as the rough upper surface of the sheet will have to be planed down before the metal is made up into a pipe. Having adjusted this to our satisfaction we fix the casting box in position with the wires, as before described. A double sheet of brown paper must be laid on each end of the bench, so that the molten metal in the box may not burn the ticking.

But, before going further, I would strongly recommend the inexperienced amateur to refrain from attempting too large a job at first. Commence by casting only a small sheet of metal, practise planing and cutting up; then try to solder pieces together by following the directions which I shall give. After that a small pipe, say 1 foot C, may be attempted, and when the requisite skill has been obtained you may commence work in earnest.

When your metal is poured into the saucepan, it must be kept well stirred, and a little more grease thrown in to keep the surface clear, and before putting it into the casting box the heat must be tested, as it will not do to use it too hot. Accordingly have ready a few strips of stout white cartridge paper, a few inches long, and about an inch wide. Plunge one of these strips into the molten metal, and if the paper only turns brown the metal is ready to use, but if the paper smokes up and consumes at once, the heat is too great.

When the right temperature is obtained, stir the metal well up and pour into the casting box, pull out the wires which secure the box to the bench, and then with a firm and uniform pressure draw the box back to the further end of the bench, and the sheet of metal will be left behind, or rather in front of the box. It will be advisable to have help in this matter, so that there may be one person on each side of the bench to draw the box along. The sheet of metal will be sufficiently cool in a few minutes to be removed, and another one can then be cast, but any metal remaining in the box must be taken out and put into the melting pot before pouring any more in. A shallow trough with a sloping bottom should be hung on to the front end of the bench to catch any metal that may run over, as shown in Fig. 1.

The sheet of metal must next be planed to make it smooth, and in order to do this it must be tacked down at one end on a level bench, and planed *away* from the point where it is so secured. If it is attempted to plane towards the fixed end, as in planing a board, the metal would ruck up and be spoilt. Care must also be taken to plane the sheet to a uniform thickness, and not to make it thinner in some parts than in others, the tendency being to run it off thin at the edges. The plane used is like an ordinary carpenter's plane, only the iron is set more upright. After planing the surface, and scraping down on both sides till it is smooth and of the requisite thickness, the edges must be turned up. The thickness of the metal will of course vary with the size of the pipe and the nature of the stop. Speaking generally, a Tenor C pipe should be about $\frac{1}{16}$ inch thick, and the smallest only about as thick as an ordinary playing card. Pipes required to give a full round tone are made of stout metal, while those required to give sharp and piercing tones are generally of thinner and closer metal; that is, metal containing a large proportion of tin.

Before finishing off the metal it should be cut to the sizes required for the pipes. I think it will be useful if I give a method by which the exact sizes and shapes can be obtained for any kind of pipe. The metal pipes are round, and the distance round a pipe, or the circumference of any circle, is within a shade of $3\frac{1}{7}$ times its diameter. For instance, suppose we want to make a pipe whose diameter is $2\frac{5}{8}$ inches, we shall require a sheet of metal which is $8\frac{1}{4}$ inches wide, which we may reckon up thus—3 times $2\frac{5}{8}$ inches make $7\frac{7}{8}$ inches, and one-seventh of $2\frac{5}{8}$ inches is $\frac{3}{8}$ inch, which added together give $8\frac{1}{4}$ inches as the distance round the pipe. No doubt to many these instructions, and those which immediately follow, will seem superfluous, but I must beg of them to bear with me, as I know from the many questions which have been asked by correspondents, that some of my readers are in great difficulty in this matter. Now if the amateur wishes to find the size of the sheet of metal for any pipe, he has only to make a scale like that in Fig. 4. This scale takes all pipes up to 4 feet long. First draw a line on a board 4 feet 6 inches long from B to D, and at a distance of 6 inches from the bottom draw a thick line across, and mark it with the word *mouth*. Now divide the line above this into two equal parts, being of course 2 feet each. At the top draw a line across and make it just as long as the diameter of the longest, or Tenor C pipe, of your Open Diapason, or whatever stop you intend to make.

If for Open Diapason this diameter will be about $2\frac{5}{8}$ in. for a chamber organ, and this distance is that marked A B on the sketch. From the point B draw a sloping line down to the point D, which is 6 inches below the mouth. The lower 2 feet of the long line is now divided into 2 lengths of 1 foot each, and a cross line drawn, marked C^2, or 1 foot C. The lower length of this is again divided into two lengths of

6 inches, and the line marked C^3, or 6-inch C ; the lower length thus obtained is subdivided again into 3-inch lengths, and so on, dividing each in half, and the cross lines at those divisions are all C pipe diameters. Now if each of these portions are divided into twelve equal parts by lines running across, we obtain the diameters of all the pipes in each octave by simply measuring the length of the cross lines at the places marked for the required pipes, while the distance from the line marked mouth up to the line of any pipe diameter will give the length of the straight tube, or cylinder for that pipe. Thus far we have an ordinary pipe scale, but if we extend the cross line at the top to the point C, and make it $3\frac{1}{7}$ times as long, that is, $8\frac{1}{4}$ inches long from A to C, that line gives us the width of the metal required to make a Tenor C pipe $2\frac{5}{8}$-inch diameter. Draw a sloping line from the point C down to the point D, and extend each of the cross lines till they touch that sloping line, and it is obvious that measuring any of those lines across from the outer line A to the outer line C, the distance is just $3\frac{1}{7}$ times as much as the same line measured only from A to B, and consequently from this scale we can get the size of any pipe in the stop, and the size of the metal required to make the tube for that pipe. For pipes extending to 8 feet long, the scale must be made 4 feet longer at the top, and that space be divided into twelve equal parts, the same as each of the others already described.

The feet of the pipes are conical, and I have been asked by many how to obtain the correct size and shape of these. Here again the matter is very simple. Suppose we want to make the foot for our Tenor C pipe, and we wish it to be 12 inches long, with an opening at the bottom 1 inch in diameter ; we first draw a section of the pipe foot as at A, B, C, D, Fig. 8, first setting up the centre line, and drawing the diameter A B $2\frac{5}{8}$ inches at the top, and 12 inches down, drawing the diameter C, D, of 1 inch from the bottom. From the points A and B draw lines down through the points C and D, and extend them until they meet in the centre line, which will be at the point E. This completes the section. Now look at Fig. 7, and making a centre line, take the distance E to A, or E to B from the section, with a pair of compasses strike an arc of a circle, as at A, B, on Fig. 7, sticking one point of the compasses in the point E. Now we must make the arc or curve thus obtained exactly the same length as the distance round the pipe—viz., $8\frac{1}{4}$ inches, and in order to do this correctly we must take a small distance in our compasses, say 1 inch, and step it round, eight times, and then add the $\frac{1}{4}$ inch to complete the distance. We have thus obtained the points A and B, and if we join these points to E by a sloping line, and then with the compasses placed at E we strike another arc, with the distance E to D ; from Fig. 8, we shall obtain the exact shape of the sheet of metal required to make a pipe foot, fulfilling the conditions laid down. This sheet is that enclosed within the lines A, B, C, and D, on Fig. 7. If this sheet is cut out and turned up, as will presently be described, it will form a cone, perfectly flat or square, as it is termed, at the top and bottom.

It takes a long time and space to describe this setting out, but the actual work can be done very quickly when you have once grasped the method.

In workshops where many stops of pipes of the same scales are constantly being made, patterns cut out of sheet iron or some similar material are kept in stock, so that for a particular pipe foot all that is required is to lay the pattern on the metal and cut round it with the cutting tool.

An ordinary amateur will not need to go to this expense, and can, therefore, either make a set of patterns out of stout paper or card-board, or simply set each one out on the metal itself.

For cutting up the metal, unless it is very stout, a shoemaker's or saddler's knife will be found sufficiently strong, but a couple of tools similar to that shown in Fig. 3 will be found very handy. They can be made out of any odd piece of steel, and fixed in a handle. The part A is ground to an acute wedge shape, and the bottom is brought to a sharp point. One of these tools should be made about the same size as the figure, for small work ; and another about three or four times as large for large work.

Having cut the metal into the required shape and form, and planed the edges true—for which purpose one of the little iron American planes will be found very handy—the pieces must be thoroughly cleaned on both sides. This is done with whiting and water, with a little soft soap mixed with it, rubbing it on with a soft pad till the metal appears clean and bright ; leave it to dry, and then finish off with wash leather. No soda must be used in the water.

The metal is now bright like silver, but before turning it up into shape it must be prepared for soldering ; that is, it must be protected from the heat of the iron. Take an old, clean saucepan and pour into it some thin glue boiling hot, and then mix a little whiting and water and pour into the glue, so as to make a mixture like thin whitewash. With a paint brush give the metal a coat of this mixture nearly an inch wide on both sides of the metal where the soldered joint is to come, and then let it dry, and give another coat.

In order to turn the metal up it has to be rolled round a mandrel or roller, and these can be made in the same manner as described in my article on Paper Pipes in Vol. II. of this magazine ; that is, by rolling

several thicknesses of paper round a long roller of wood, until the requisite size is obtained.

To bring it round the roller slip the sheet so that it laps over the edge of the table about half-an-inch, and slip under that edge a lath of wood cut feather edged, and as long or longer, than the sheet of metal; place the mandrel on top of the sheet of metal, and with the thumbs placed under the slip of wood, gently bring the metal round the roller. This operation requires great care, as it is very easy to thoroughly spoil the sheet of metal if it is clumsily done.

Those of my readers who have experimented in making paper pipes will have acquired the knack necessary to bring the paper or the metal straight and smooth over the mandrel. Before folding down close to the mandrel the edges of the metal to be soldered together must be first gone over with the little iron plane, so as to take off any of the whiting that may have run on to them, and they must be planed so that they only touch on the under side, forming really a V-shaped groove for the solder to run in, as shown in sketch, Fig. 13. It must specially be noted that these edges must not be scraped or filed, but clean and smooth with the plane or with a shave-hook, otherwise you will assuredly fail to make a joint with the solder. The little iron planes will be found the best tools to use, and they can be purchased for about 1s. each, at almost any tool shop. Having got this matter all right, the edges of the metal must be brought together and pressed closely down to the mandrel by gently pressing a slip of wood on them. This slip should be shaped somewhat like a paper-knife, and may be about 10 in. long, 2 in. wide, and $\frac{3}{4}$ in. thick, without any sharp edges, as the metal must not be dented or wrinkled in any way. If the glue sizing has chipped off at all, it must be replaced with fresh, and allowed to dry before proceeding to solder. In order to keep the edges of the metal together for soldering, the amateur may find it

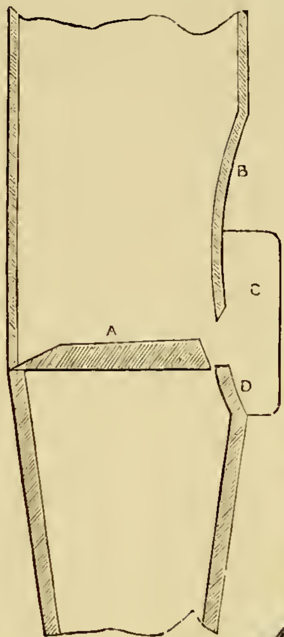


FIG. 15.—ENLARGED SECTION OF MOUTH OR SPEAKING PART.

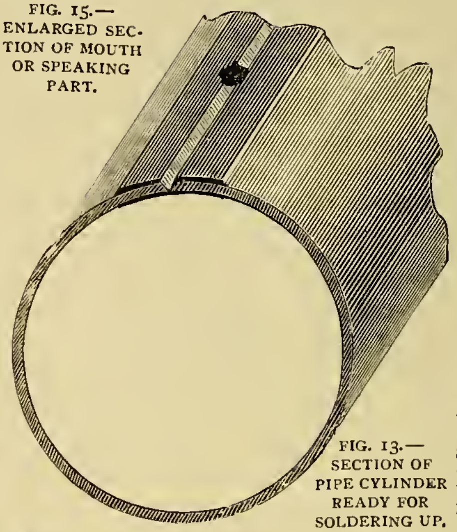


FIG. 13.—SECTION OF PIPE CYLINDER READY FOR SOLDERING UP.

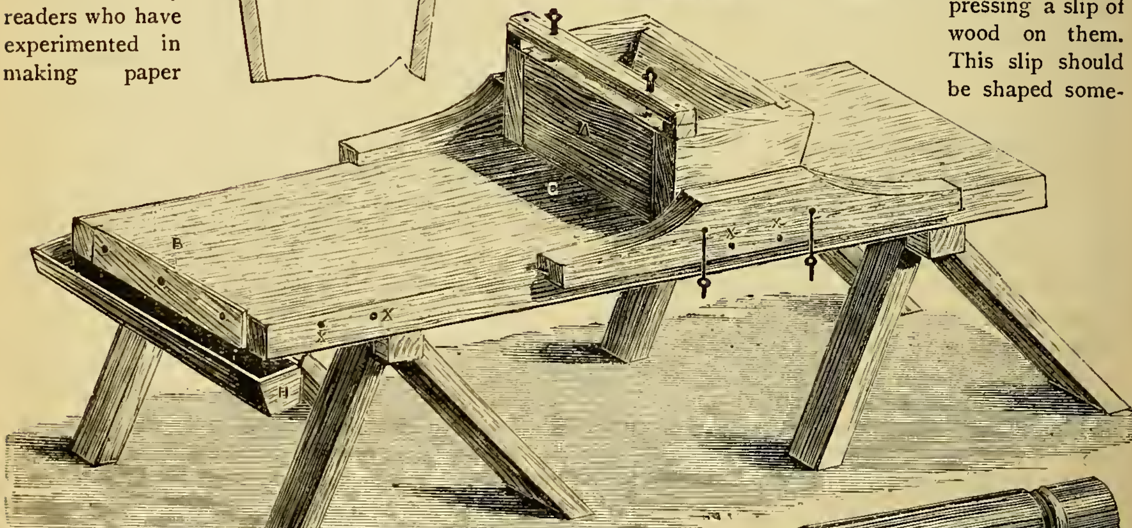


FIG. 1.—VIEW OF CASTING BENCH AND CASTING BOX.

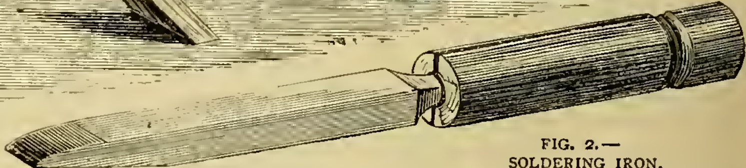


FIG. 2.—SOLDERING IRON.

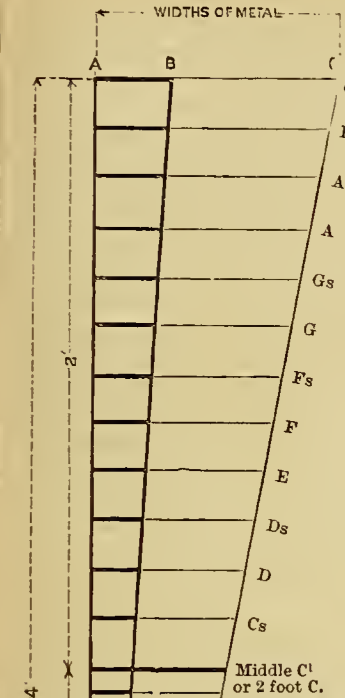
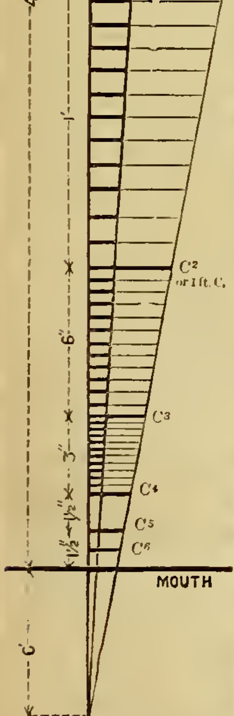



FIG. 4.—SCALE OF PIPES AND SIZE OF METAL REQUIRED TO MAKE THEM.

FIG. 5.—SECTION OF COMPLETE PIPE.

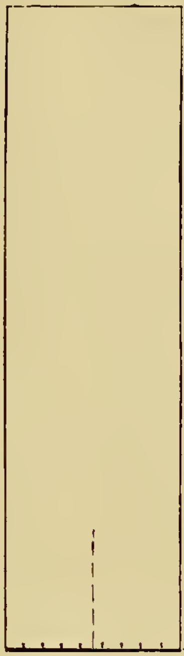
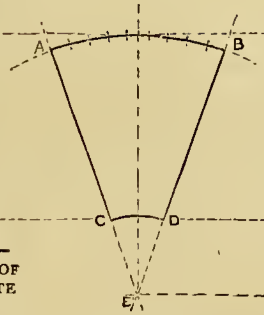


FIG. 6.—SHEET OF METAL CUT TO SIZE OF PIPE.



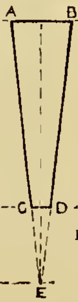


FIG. 7. FIG. 8.
METHOD OF OBTAINING CORRECT SIZE AND SHAPE OF PIPE FOOT.

FIG. 9.—CYLINDER AND FOOT READY TO SOLDER TOGETHER.

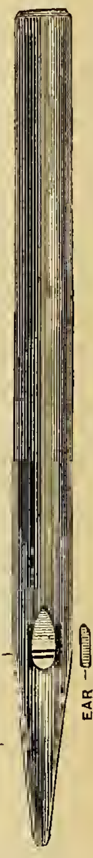


FIG. 10.—PIPE COMPLETE.

FIG. 14.—CONE FORMING LIPS.

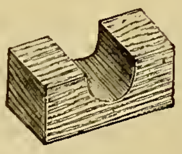


FIG. 16. BLOCK TO SUPPORT PIPES.

FIG. 12.—SECTION OF LANGUID.

FIG. 11.—LANGUID.

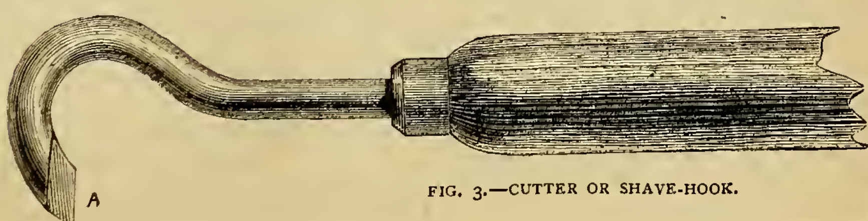


FIG. 3.—CUTTER OR SHAVE-HOOK.

convenient to bind it round here and there with a piece of broad tape, A few blocks like Fig. 16, with semicircular hollows of different sizes, will be handy for supporting the pipes, both for this and succeeding operations. The soldering-iron used is really an iron, and not a copper bit. It is shaped as shown in Fig. 2, and the square part is made of well-hammered iron, 4 or 5 inches long and 1 inch square, with a rather thin tang, which slips into the wooden handle, but is not permanently fixed therein. The handle is made in two pieces, which are merely held together by being bound round with wire, as shown, at the end furthest from the iron, so that it can be slipped on and off the iron as required. Rub a piece of tallow candle all along both edges of the metal where it is to be soldered, make your iron hot, put a piece of solder in the hollow part of a clean brick, add some resin, and *tin* the iron, as it is termed, by rubbing the sloping part in the solder and resin, so as to give it a coating of solder. To a beginner this tinning of the iron is a troublesome job; but until it is accomplished it is impossible to take up the solder on the iron, so as to make a joint. The iron must be clean, and hot enough to melt the solder readily, but not so hot as to perish it; practice alone can enable any one to judge of the amount of heat required.

A little piece of composite candle will be found of great assistance to enable the solder to be taken up on it. This should be placed along with the solder in a hollow block of wood, and whenever you require more solder, touch the iron on the candle first and then take up the solder. First tack the pipe together by dots of solder about 3 inches apart, then take up more solder and connect the dots to one another. Finally, with the iron tolerably hot, run down the whole length of the joint, so as to make the solder flow in a clear bright line. If the iron is too cold, this joint will look rough and botchy, but with a nice hot iron, the joint is smooth and workmanlike. Fig. 13 shows the pipe turned up ready for soldering, the thick lines indicating the glue sizing, and the black dot on top a dot of solder for tacking.

Having soldered up the tube or cylinder, we may proceed to perform the same operation with the conical foot, which must be turned up on a mandrel of the requisite shape. The directions given in my first chapter in Vol. II. for making the mandrels for the feet of the paper pipes will apply here, but the mandrels must be made rather more substantial than is needed for turning paper on. The paper mandrels can be much more quickly made than wood ones, are cheaper, and can be increased in size as required for larger pipes by merely gluing more thicknesses of paper round them. The feet of the pipes, especially large ones, should be cut out of thicker metal than the tubes, so as to be strong enough to support the weight of the pipes without doubling up. When the feet are soldered up, the mouth must be cut in the tube and the lips formed.

The width of the mouth for the Open Diapason will be two-ninths of the diameter of the pipe, and its height will be one-fourth of its width. In order to cut the mouth, a metal or hard wood cone is inserted in the pipe, and a cut made at each side of the mouth to the depth required, and then another cut is made across to join the two cuts, thus taking the piece right out. The small size tool (Fig. 3) is used for this purpose. One side of the metal or hard wood cone is squared off, as shown in Fig. 14, and this flat part is now brought under the portion of the pipe immediately over the mouth, and the lip is then formed by gently rubbing the metal down with a burnisher, so that it assumes the form required. The bay leaf, as the ornamental upper lip of the show pipe is termed, is formed before the pipe is turned up, by marking out the shape on the inside, and rubbing a burnisher round the line, thus causing a ridge to show on the outside of the pipe.

In large pipes, the bay leaf is formed separately and soldered in. The same process is repeated on the top of the foot to form the lower lip, only it must be remembered that the lower lip is not made so deep as the top one, and that it must not take so much off the diameter of the foot, as a windway is to be allowed for. The pipe may now be cleaned off inside and out with a wet sponge and a little whiting, which will get off all the sizing; a little mop, like that used for paper pipe painting, being used to clean the inside of the metal pipes.

The languids may now be formed and put on. They are simply pieces of thick metal cut to fit on to the top of the pipe feet, and shaped as shown in Fig. 11, and in the sections Figs. 12 and 15. For a Tenor C Open Diapason, they may be a full $\frac{1}{4}$ inch thick, while for the smallest pipe in that stop, they may be about $\frac{1}{16}$ inch thick. It will be observed that they are sloped off all round the curved part to a very thin edge, so that when placed on the top of the pipe foot, and the tube on top of all, the joint is scarcely seen. The angle of the slope of the languid at the mouth should be about that shown in the section Fig. 15, but some makers slope it further back. Now, polish the languid up, size it round with glue and whiting, serve the top of the pipe foot the same, trim off to form a slight V groove for the solder, place the languid on the foot, and solder it by dots, and then join all round the curved part, leaving the straight part open for the wind to pass. The under side of the languid should be just level with the top of the lower lip. These processes may now be repeated,

and the tube joined on to the foot, taking great care that the mouth comes in its proper position, and that the foot and the tube are perpendicular to each other, as unless this is the case, the pipes will lean in all directions when planted on the soundboard, looking very unsightly, and occupying an unnecessary amount of space.

The ears are now to be cut out and soldered on, taking care to size with glue and whiting as before described. The ears are merely small pieces of metal shaped as shown in Fig. 15, and placed one on each side of the mouth to prevent the wind, which should impinge on the upper lip, being wasted. In Fig. 15 A is the languid, B the upper lip, C the ear, and D the lower lip. It must be remembered that the seam or joint should be at the centre of the back of the pipe and foot. It now only remains to chamfer off the edge of the upper lip, and to cone in the hole at the bottom of the foot. The chamfering may be done with a small shave-hook or a sharp penknife, and the foot is coned by means of a hollow metal or hard wood cone being struck and worked round it until the hole is reduced to its proper size. The directions and dimensions given in pages 22—28 in Vol. II. will apply generally to metal pipes, and the instructions in voicing and tuning, etc., given in Chapters 14 to 16 in Vol. III. are so comprehensive that it is needless to take up more space by repeating them here.

It may be useful if I mention that Mr. W. J. Burton, *of Ringwood*, *Hants* (an organ builder by trade), is prepared to supply amateurs with all requisites for organ building, including complete stops of paper pipes, at a very moderate cost.

In another chapter I propose to give instructions to enable amateurs to make their own reed pipes.

(*To be continued.*) 386

SMITHING AND FORGING.

By GEORGE EDWINSON.

IV.—DRILLS AND DRILLING APPARATUS.

IN my second paper on this subject, I referred (p. 211) to the need of some sort of drilling apparatus, and the illustration on p. 213 contains a sketch of the usual drilling brace found in country shops. I will now, with my reader's consent, give instructions on making a drilling brace and all its accessories.

Drilling braces may be made in a variety of sizes, to suit the work to be done with them and the sizes of drills to be carried in them. A large brace will be required for large holes in thick plates, because an advantage will be gained by having a long angle and corresponding leverage between the hand of the workman and the centre of the drill; whilst on the other hand, a light brace with a short angle will be most convenient in light work with small drills. Workers in copper, brass, silver, etc., use lighter braces than those usually found in a smith's shop, where such tools as Archimedean screw drill braces, fiddle-bow and drill, and other such light drilling tackle would be deemed out of place. A very useful size brace for an amateur smith would be one of the following dimensions:—Length from A to B (Fig. 54), 3 inches; from B to C, 6 inches; from C to D, 8 inches; from D to E, 6 inches.

To make this brace, proceed according to the following directions: Take a piece of $\frac{3}{4}$ inch round iron, 20 inches in length. Take a welding heat on one end, close up, draw out about one and a half inches, flatten to $\frac{1}{2}$ inch in thickness to form an eye, scarf the end of this, turn the eye over the beck of the anvil, as shown in Fig. 55, then return to the fire. Heat again to welding heat, and weld up the junction; then put a $\frac{1}{2}$ inch round bolt in the eye and shape up on anvil. Treat the other end of the bar in a similar manner; but in finishing the eye, form it upon a square taper bolt or mandrel, ranging from $\frac{3}{4}$ to $\frac{1}{2}$ inch, as shown in Fig. 56. This will form a socket for the shanks of the drills, and must therefore be formed true on all sides. Next get a $\frac{1}{2}$ inch steel bolt, 3 inches in length, fit it into the eye first made, get both to a welding heat and weld them together. In welding steel to iron there exists a danger of overheating the steel before the iron is hot enough to weld. To obviate this, protect the surface of the steel with a coat of silica by throwing some clean sand on the heated metal whilst in the fire, and turn it around occasionally whilst being heated to the required heat.

The next stage of progress will be, measure off 6 inches from the part marked B, and dot it with a centre punch; heat the dotted part to a red heat, and bend that part of the brace to the required angle; then treat the corresponding end in a similar manner, making sure to have the smaller end of the tapering eye uppermost, and the centre of the eye in a line true with the centre of the steel pin above. When all has been set right, take off marks of rough workmanship with a few file touches, and grind the tip of the steel pin to a taper point. Some persons are content to use this brace as made, and to allow the handle part to revolve in the hand of the workman; others prefer to bend a piece of sheet iron around this part to act as runner or guard for the hand, as shown in Figs. 13 and 14, p. 213; this can be easily done if desired,

The details of fitting up the lever above the drilling bench, as shown Fig. 14, need not be given here, as the sketch shows clearly how this is done. When the lever is made entirely of iron, it is only necessary to dot the under side of it with a number of centre punch marks to fit the point of the steel pin on the top of the brace. Some persons prefer a wooden lever, and this is then faced with a plate of iron dotted with centre punch marks.

Whilst writing on the subject of drilling braces, I may mention that the forms of the drill shanks and the corresponding form of the sockets to receive them, vary in the tools of different makers. Some forge the heads of the shanks square and true to fit a square socket, and the drills are secured therein by a set screw passing through the sides of the socket. Others drill a round hole in the lower part of the brace, and turn the shanks of the drills to exactly fit this hole. To prevent these from turning round, a nick is made on one side of each, and a set screw is inserted to hold the drills firmly. I consider the form herein described to be the most simple and easiest mode, whilst it is equally effective for a smith's purpose with those of other forms. The chief objection to be raised against it is, that it necessitates heavier drills than the form last mentioned. Still another improvement in drilling apparatus should be mentioned here, but the amateur smith will not be able to make it with the tools already described. The upper part of the brace is not supported under a lever, but is held under an arm tapped to receive a coarsely-threaded screw bolt. The head of this bolt is perforated with cross-holes, as shown Fig. 57. The improvement consists in being able to adjust the pressure required, to a nicety with the left hand, whilst turning with the right—this is done by turning the screw bolt with the left hand, and make it take up a thread or two of the screw as the hole deepens. The bracket can be adjusted to any height, and the portable frame holding the bracket may be used away from the bench if required.

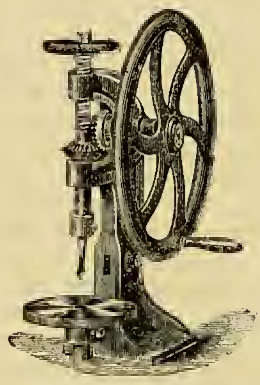


FIG. 60.—WINN'S CHEAP BENCH DRILLING MACHINE.

Another form of brace, constructed principally for use in cramped and confined positions, is that known as a ratchet brace, shown at Fig. 58. This tool, as the name implies, is worked by means of a short lever fitted with a spring pawl made to engage with a ratchet wheel on the stem of the tool. The lower part of the tool is furnished with a socket for drills, and the upper part, or head, is fitted with a screw bolt and point to regulate the pressure. This tool is rarely required by a smith, but it is an almost indispensable one to the millwright and wheelwright.

But drilling-braces, such as those in ordinary use, must yield the palm to the modern drilling-machine with its superior advantages of speedier and more accurate work. Not many years ago, it was impossible to secure a machine suitable for a smithy, because there were none other except those made to be driven by steam power or similar means. Now, there are some good hand-machines in the market, one such I have shown at Fig. 59, which represents a small machine sold by Mr. Evans, *Trumpet Street*, *Gaythorne*, *Manchester*. Fig. 60 shows a machine made by Messrs. Charles Winn and Co., *Birmingham*, and sold at the moderate price of three guineas. It drills holes up to ¾ inch diameter. The table is 9 inches in diameter, and the total weight of the machine is 80 lbs.

Drills.—The next and most important part of the drilling apparatus is—the drill. However perfect the brace, lever, adjusting-screw, machine, or other part of the tool, it must fail in doing good work if the drill is imperfect; but, on the other hand, a good drill may be made to turn out good work even when all other parts are indifferently made. The requisites for a good drill are as follows: 1. Good tool steel. 2. Forging to the right shape and substance. 3. Properly tempering the steel. 4. Grinding to the right angle and cutting edge. First, then, as to quality of metal. This must be of the best tool steel procurable. A ¾ inch square bar will be the size in use for drills to fit the brace first described. Such steel can be got from

Messrs. Fenn, Buck, or Melhuish, *London*, or other tool dealers at prices from about 9d. per lb.

Secondly, the best attention of the smith must be paid to forging the drills. Special attention must be given to heating the steel, for if this is over-heated or "burnt" it will be irretrievably ruined, and should be at once thrown on the scrap heap. No subsequent carefulness will restore to it the carbon burnt out by overheating, nor will any tempering restore its first toughness. In forging drills, heat the metal to no tongs, and forge the head to fit the brace socket. Heat up finally to a dull red, finish with a few light touches when required, set it true, and lay aside to cool. In forging the head see to it that all sides of the taper are equal, and the centre of the shank and blade is set true with the centre of the head, this must be done before it is set aside to cool. Various sizes of drills should be forged, and it must be born in mind that the shanks must be made of a size proportionate to the blades. Thus the shank, for a quarter

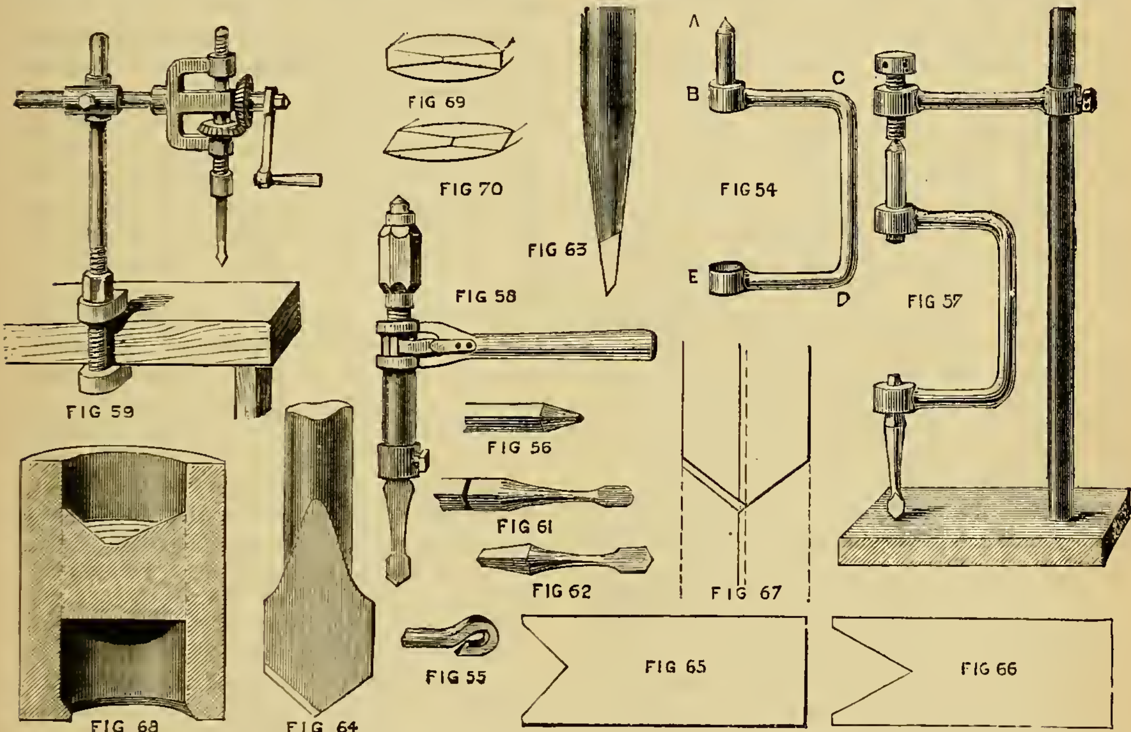


FIG. 54.—DRILLING BRACE. FIG. 55.—MODE OF TURNING EYE FOR BRACE. FIG. 56.—SQUARE TAPER PUNCH OR MANDREL. FIG. 57.—BRACE IN POSITION UNDER MOVABLE BRACKET. FIG. 58.—RATCHET BRACE. FIG. 59.—EVANS'S DRILLING MACHINE. FIG. 61.—PROCESS OF MAKING DRILL. FIG. 62.—FORGED DRILL. FIG. 63.—TAPER OF DRILL BLADE. FIG. 64.—DRILL FOR CAST IRON. FIGS. 65, 66.—GAUGES FOR DRILLS. FIG. 67.—DIAGRAM ILLUSTRATING BADLY GROUND DRILL. FIG. 68.—WORK DONE BY BADLY GROUND DRILL. FIG. 69.—POINT OF DRILL GROUND WITHOUT CLEARANCE. FIG. 70.—POINT OF DRILL SHOWING PROPER CLEARANCE OF EDGES AND CORNERS.

higher heat than that indicated by a blood-red tint, and hammer it down to a dull red, only before returning it to the fire. After the steel has been drawn out, and when finishing off the blade of the drill, it may be hammered at a lower temperature. To forge a drill, proceed as follows: Cut off a two-foot length of $\frac{3}{4}$ inch square bar tool steel, and heat 3 inches of it to a blood-red in a clean fire. Draw out the blade and shank part of the drill first, as shown Fig. 61, and form it as nearly to shape as possible. Then cut off the required length to form the taper square head, hold the blade and shank in a pair of flat bit grooved drill, should be only half the thickness of a $\frac{1}{2}$ inch blade. The drill blades from $\frac{1}{2}$ inch down to $\frac{1}{4}$ inch may be regulated to size by grinding, if left a little fuller than required, indeed they should always be left slightly larger, to be reduced to the desired size by grinding. Now as to shape, and this is most important. In this class of drill there should be a gradual taper from head down to shank, then an uniformity of size for an inch or two, the blade should then gradually swell out and be thinned down toward the point, as shown by the Figs. 62 and 63.

If the shank is made too thin, or the changes in

thickness rendered too abrupt, the drill will be apt to snap in working. The thickness of the blade must also be proportioned to its width, and care must be taken to avoid a fanciful thin blade with fine cutting edge; rather err in the opposite direction than run the risk of making a drill too thin. They may run from a $\frac{1}{16}$ at the point to $\frac{1}{8}$ at the corners in a $\frac{1}{4}$ inch, up to $\frac{3}{16}$ for a $\frac{1}{2}$ inch or $\frac{3}{4}$ inch drill. The final touches, both in substance and shape, will be given to the drills at the grindstone.

Tempering.—When steel is heated and allowed to gradually cool, it loses its hardness and elasticity and becomes almost as soft as iron. Those properties may, however, be restored to it by carefully heating it and cooling it in water or in oil, if it has not been overheated in working. Almost any desired hardness and rigidity may be imparted to a properly forged drill made out of good steel. Its point may be made hard enough to cut glass like a diamond, or it may be left soft enough to have its edges bent in drilling hard wood. Its shank may be left so elastic as to allow it to be bent aside and yet to spring back again straight, or it may be left soft as iron, or it may be made so hard and brittle as to snap like glass when slightly jarred. Whilst practically feeling my way along in acquiring experience in drill tempering, I frequently erred in both directions, and had the mortification of seeing the drill shank twisted like a corkscrew before the machine could be stopped, or, at another time see it snap off short when the drill encountered a hard bit of metal. As a result, I am prepared to advise tempering the shanks of the drills at the same time as the blades are tempered. Steel is made hard and brittle by heating it to a bright red, and suddenly plunging it into ice-cold water or into mercury. When heated to a high temperature, such as indicated by a yellowish approaching to white tint, and then plunged into very cold water, it is made brittle like glass, and will sometimes crack like glass when taken out of the water.

In a future paper, I hope to give some detailed instructions on tempering steel for various purposes, so will merely give here instructions on tempering the drills likely to be used in the smithy. When the drill has been forged to the right shape, and set true, heat it to a red heat and plunge it straight downward into cool water, holding it there until cold. The water must not be icy cold, but only from 45° to 50° Fah. If plunged into very cold water, the edges are apt to be brittle. Brighten the blade and part of the shank by rubbing on a brick, or on a piece of grit-stone. The drill may now be tempered, that is reduced to the desired hardness in the following manner:—Make a piece of stout iron red hot, lay the shank of the drill across the heated iron and note the change of colour in the brightened shank and blade. The tints will run from the shank towards the blade. First the shank will show a straw tint, followed quickly by yellow, then orange yellow, then purplish yellow, then purple, dark blue and light blue. The light straw tint followed by bands of the other tints, will run forward toward the blade, where they must be arrested according to the following instructions. If the drill is intended for cast iron and hard brass, allow the pale straw tint to reach the blade, then dip this part in water, take it out and again note the tint; keep the orange and blue back by dipping the blade occasionally in the water and thus allow the shank to cool in air. This will leave the blade hard, and the shank tough. If the drill is intended for drilling wrought iron, soft steel, or copper, the blade must be tinted to an orange yellow before it is cooled. If for woodwork only, the blade and shank should attain a purplish yellow tint and then be cooled gradually. The whole drill will then be only slightly hardened, and the shank will be tough.

A method of tempering drills, adopted by experienced hands, is as follows: Brighten the newly-forged drill whilst hot by rubbing it with a piece of grit-stone, watch the gradation of tint whilst resting it on the anvil, and cool off as before directed. Very small and fine drills, made from steel wire for delicate work, are tempered by holding the blade in a pair of pliers, and heating the shank on hot iron or in the flame of a spirit lamp or Bunsen burner. Or they are heated to a red heat and plunged into wax or into a candle and cooled therein. Drills for hard steel, glass, and china, must have their blades or extreme edges hardened by plunging them in mercury.

Grinding Drills.—The operation of grinding the drills, is equal in importance to that of forging and tempering. A properly ground drill will work freely and turn out good work, whilst a badly ground drill will be a source of trouble and vexation to its worker. As in tempering, so in grinding, we must be guided in our work by the thought of the use to which the drill must be devoted after it is ground. If for cast iron or hard brass, the angle may be very obtuse, and the cutting edges coarse, as shown in Figs. 64 and 65. If for wrought iron, tough steel, and copper, the angle should be more acute, as shown at Fig. 66. The two last figures represent gauges intended to act as guides to novices in drill grinding. These gauges are formed of thin sheet iron or brass with notches filed in them as shown. The drills are ground to fit the notches as required, to get the desired angle. In grinding drills, some care must be taken to get both cutting edges equal with the point of the blade exactly in a line with the centre of the drill. A slight departure from this, even to the small extent illustrated at Fig. 67

will cause the point of the drill to gyrate around the true centre of the blade, the work to shake and wobble, and the whole to deviate at the bottom from the straight line as shown at Fig. 68. The cutting edges should not be so thin and sharp for cast as for wrought iron, but for both purposes the corners must have a good clearance. Fig. 69 shows the point, edges, and corners, without any clearance; Fig. 70 shows the right shape to be given to the corners, point, and cutting edges of the blade. Fig. 63 shows the correct taper to be given to the blade of a drill when looked at edgewise, but it should be noted that the blade of this drill is not long enough to clear itself free from borings. Fig. 64 shows a drill suitable for drilling cast iron and brass, but this form would not do for wrought iron and tough metals. Not only is the cutting part too obtuse, the blade is also too short and thick. In these and other lessons I have always sought to lead my readers away from stiff cut-and-dried methods of doing work, into those in which they must think for themselves. I have therefore given an insight into the general principles commanding success, and leave the task of putting these into practice, to the intelligent workman. A writer on the subject of "Working Steel" has truly remarked that steel tools partake of the character of their makers. After one has placed on paper the needed instructions on heating, forging, and tempering the metal and shaping the tools, the individuality of the workman steps in and shows itself in the finished article.

In my next paper I hope to deal with the subject of Taps, Dies, and Screwing Apparatus.

(*To be continued.*)

A HANDY CUPBOARD IN FRETWORK.

By J. W. GLEESON-WHITE.

ONE of the most useful, odd pieces of furniture in a room is a small cupboard, large enough to take the little bottles and boxes that lurk on the mantel-piece or hide in the corners of the sideboard cupboards for want of a convenient place to disappear, and yet be at hand when wanted; especially is this the case in a bedroom, as hardly any one is so favoured by health as to be entirely free of pill-boxes or small bottles of remedies from toothache to the more serious of the maladies that modern life is subject to: therefore I think that no apology is needing for suggesting a form so destitute of novelty as a small hanging cupboard. I have hesitated to call it a medicine cupboard, as it may be used for any other purpose equally well; but no doubt the owner will soon find a use for it; and I fancy that few articles would find more favour at a bazaar, or be more welcome as a birthday or other present, by high, low, young, or old, than some such sort of cupboard as this one.

To describe at length making a cupboard of this sort seems to be almost superfluous, as any one who is not frightened at the thought of building a rabbit-hutch—and that, I fancy, includes at least the English-speaking youth throughout the world—may pluck up courage and attempt such an one as this.

First, the choice of wood is unlimited, and may be left free to the would-be maker. Whatever it is, it will need two stout pieces, not necessarily over half an inch in thickness, for the sides. If the fretwork is added at the top, as shown, these may be cut bracket-fashion below, and the top left plain; or, better still, the fretwork (if convenient) worked in the piece itself. These two pieces may be screwed, in lieu of better fitting, to three other pieces, placed shelf-fashion—one just above the top of door, one midway, the other just below the door. If these "wobble" when fixed—though they ought not to do so—a back of thin boards nailed on, with the edges bevelled to avoid unsightly appearance at the sides, will assist in keeping them taut and firm. The door may be cut in one piece; but, if within the bounds of possibility, let it be a nicely panelled frame, with the two openings filled with the fretwork; cut about $\frac{1}{4}$ to $\frac{1}{2}$ inch of square margin round the panels, and let in (like glass) to rabbets in the framing, or, better still, put in grooves proper panel fashion, if it can be done.

It is needless to say that the more workmanlike a finish is made, the better will be the result, and the suggestions for the simpler way may be treated with the contempt they deserve by those who are able to go to work in a professional way.

The fretwork looks well, if painted with the bronze powders now literally sold everywhere: these may be applied the last thing. Supposing, for instance, the cabinet is ebonized, and the fretwork bronzed, let the leaves be all green of different shades in the design; the fruit gold, shading to crimson; the flowers silver, shaded with pink; the lattice of a diaper pattern, plain gold. This will make the whole thing quite in keeping for a drawing room ornament, and add to the effect of the fretwork greatly. If bronzed, either glass or polished wood, black (of course), may be put behind the fretwork, both to strengthen the work and to keep the dust from the contents of the cupboard.

A turned balustrade might be used in place of fretwork rail to the top, with good effect, and the lower part might carry a narrow shelf below the door, some 5 inches down, the brackets being shaped to take it. If this is so, the space between shelf and cupboard should be boarded and lined with looking-glass, plush,

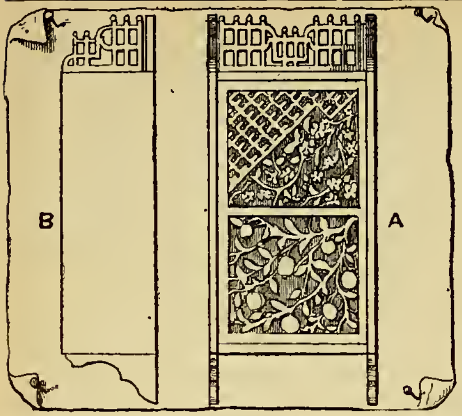


FIG. 1.—FRONT (A) AND SIDE (B) OF CUPBOARD.

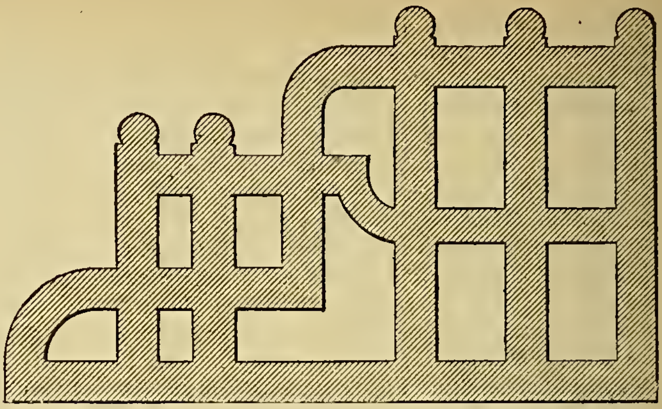


FIG. 2.—SIDE OF LEDGE AT TOP OF CUPBOARD—HALF SIZE.

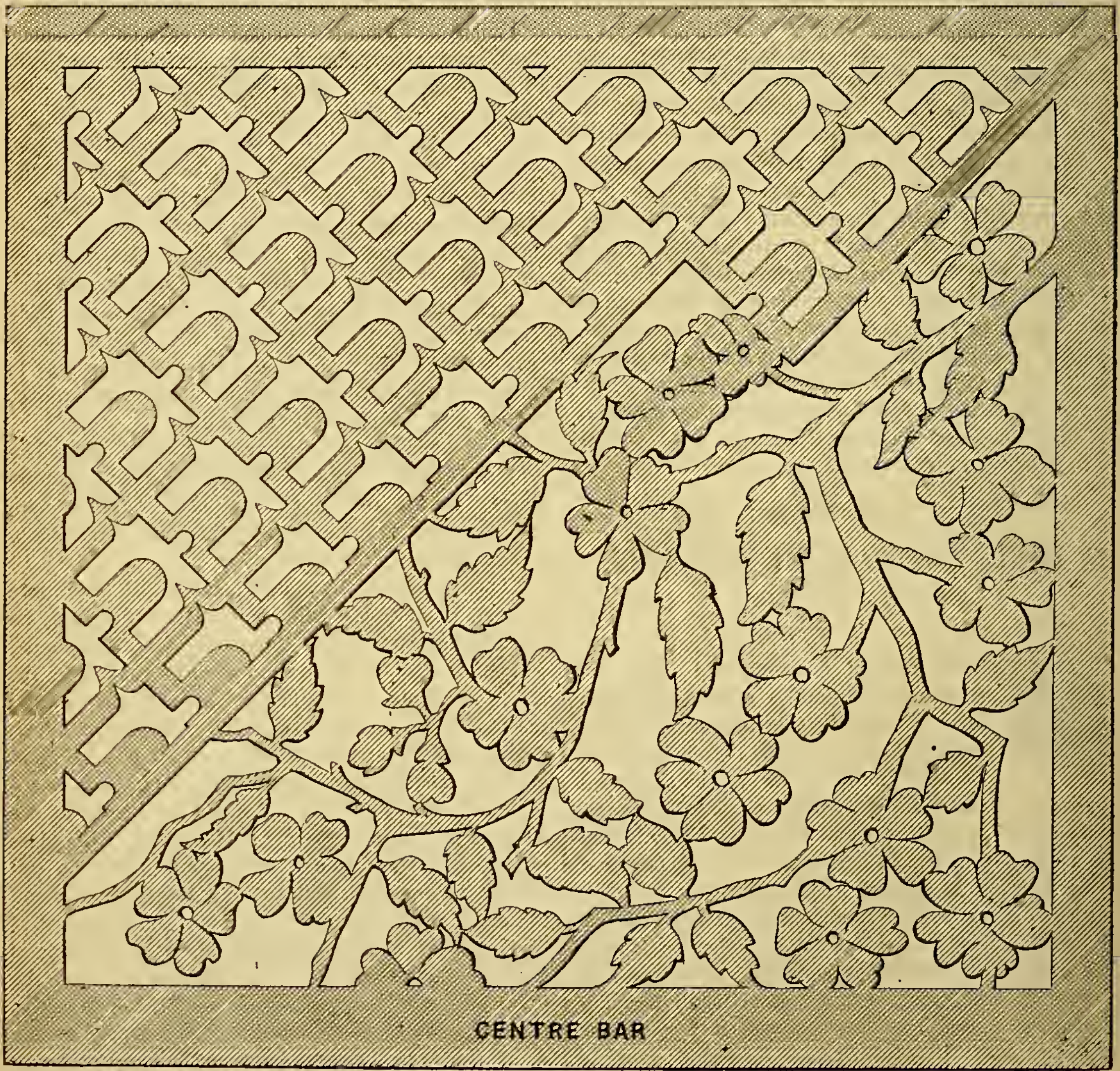


FIG. 4.—PANEL FORMING UPPER HALF OF CUPBOARD DOOR, INCLUDING BAR IN CENTRE—HALF SIZE.

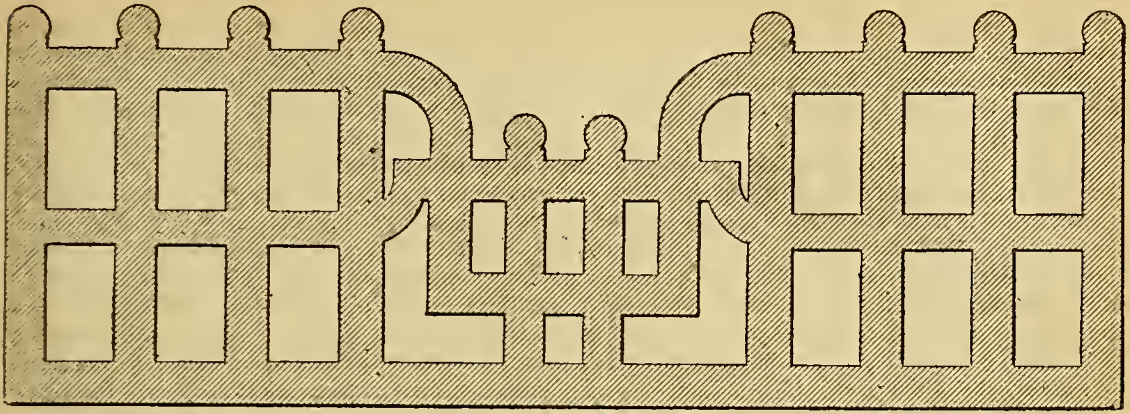


FIG. 3.—BACK OF LEDGE IN FRETWORK AT TOP OF CUPBOARD—HALF SIZE.

FIG. 5.—PANEL FORMING LOWER HALF OF CUPBOARD DOOR, INCLUDING BAR IN CENTRE—HALF SIZE.

or velvet, to make the whole look like one piece of work, and not like an after-thought.

Ornamental hinges, an escutcheon for keyhole, and ring handle, would be better, if attainable, but are not necessary.

If used as a medicine cupboard, it is suggested that the shelves should have a low piece of plain wood as a rail in front, to prevent a sudden jar tilting the bottles off the shelves. The shelves themselves should be arranged to take bottles of various heights, while a very low shelf should be left for pill-boxes and small pots.

As space is valuable and Folding Sheets limited in number, the working drawings of the fretwork ledge surrounding top of cupboard (Figs. 2 and 3), and of the panels forming the cupboard door (Figs. 4 and 5) are given half size. They can be easily enlarged to full size by means of the pantograph, or by making a tracing and dividing it into squares. Thus, if the illustrations be divided into squares measuring ½ inch each way, the squares of the full sized working drawings should be 1 inch each way. The general appearance of the cupboard when complete may be gathered from the sketches of the front and side given in Fig. 1. Any other detail, on which I may not have been sufficiently explicit, shall be explained, if desired, through the columns of "Amateurs in Council."

DRY-PLATE PHOTOGRAPHY:

THE GELATINO-BROMIDE PROCESS.

By C. C. VEVERS.

IV.—LANDSCAPE PHOTOGRAPHY.

I WILL take it for granted the amateur has got his dark room completed, has obtained apparatus such as was described in the last paper, and is now impatient to try his hitherto unpractised hand at practical photography. He has yet, however, to obtain a few other necessary materials before he can expose a plate with any possibility of his obtaining a passable picture.

For ordinary landscape photography he will require :—

(1) Camera, lens, dark slides, tripod and focussing cloth.

(2) * Case for carrying apparatus.

(3) Dry plates.

(4) * Dust brush, as in Fig. 23.

(5) * Changing bag and plate boxes.

(6) Note book.

Of the Camera, Lens, etc., nothing more need at present be said, as I assume the amateur has procured these to his satisfaction.

The Dry Plates.—A dry plate is a sheet or plate of glass, one side of which has previously been coated with a film of emulsion, and dried. Photographic emulsion is composed of gelatine in which is held in suspension the salts of silver, bromide, and one or two other chemicals (in certain proportions) in a fine state of division, forming a mixture which is exceedingly sensitive to light. The process of making an emulsion is somewhat beyond the scope of the beginner, but I may, with the editor's permission, at some future time, contribute a paper on the subject. Dry plates are, however, an article of commerce, and the amateur photographer will find no difficulty in obtaining them in small quantities at any photographic dealer's ; they are usually packed and sold in cardboard boxes containing one dozen, and, of course, the prices vary according to the size, quality, and sensitiveness of the plates. Of the very many brands of plates now in the market, the amateur should—*must*, in fact, select one make, and work with no other ; by doing this he will have opportunity to study that particular make of plate, learn to modify his developer to suit its peculiar qualities exactly, and finally produce much better results than if he were to be continually "trying" different makes.

The plates I recommend the amateur to use for ordinary work—such as landscape groups and portraiture—are those formerly sold by Messrs. Marion and Co., as their "Britannia" plate, but which were manufactured by "the Britannia Works Co.," *Ilford*, who still make and sell them under the trade-mark, "The *Ilford* Dry Plate ;" the amateur must not, therefore, confound these with the "Britannia" plates now sold by Marion, as they are an entirely new manufacture which I have never tried. I have tested the "Ilford" plates (which are now coated by machinery) and find them equal, if not better, than the old brand. The price, too, has been considerably reduced ; they may now be obtained through any dealer at 1s. dozen quarter size, 2s. 3d. dozen half-plate.

Excepting for instantaneous photography, indoor portraits of children, and other exceptional cases, the *slowest* plates should always be used, as they are much easier to manipulate than quick ones.

* In this and future lists of photographic materials and chemicals, an asterisk (*) preceding an article denotes that the article thus specified is not absolutely essential in *every* case, but, although the amateur *may* defer purchasing it if necessary, I think it advisable he should have it at hand, so that no delay may occur when its use is requisite. I may here state that I shall never mention any article that will not, at some time or other, be of real practical value to the amateur photographer.

Camera Case.—For excursions, and when the photographer is going a distance from home, he should have some sort of bag in which to carry the camera, lens, and dark slides, and to protect them from the effects of the weather. A "Gladstone" bag may be used for this purpose; but cases divided into compartments and made expressly for carrying the apparatus, are to be had from the dealers. Marion sells a case of solid leather, with sling strap for carrying over shoulders, to take a Middlemiss half-plate camera, lens, and three double backs, at 18s. Lancaster offers one made entirely of best leather, lined with velvet, and partitioned to carry camera, lens, three double slides, top of stand, etc., and fitted with nickel plated lock and key for 25s., half-plate size. Cases are also to be had for carrying the tripod, but I have always found a strap, such as is used for carrying a rug or books, sufficient for this purpose.

The Changing Bag.—I myself use extra dark slides in preference to this, at best, cumbersome addition to the amateur's kit, and although the first cost is necessarily somewhat high, this outlay is soon saved in the decrease of spoilt plates, loss of time and trouble always attendant on a changing bag. The amateur who is in possession of half-a-dozen double backs is enabled to expose twelve plates, which should be ample for any one day's excursion, without the use of a troublesome changing bag. However, should the amateur decide to use one, he will find no difficulty in making one out of three or four thicknesses of black twill. Shew, of 88, *Newman Street, W.*, sells one, measuring, when expanded, 13 by 10 by 10 inches, for 15s. 6d. Marion also offers one "to fasten round the neck, so that the bag is suspended in front of the operator," for 12s.

The Plate Box.—When a changing bag is used, a plate box is essential, but the amateur should also have one or two about the dark room into which he can put the plates if the cardboard box, in which they are originally obtained, should get damaged; indeed, it is advantageous to always transfer the plates from the cardboard box to the plate box. Plate boxes are made of wood, leather, or tin, and are internally fitted with grooves to take plates of a certain size. Marion has a very good and cheap box—which I here illustrate in Fig. 24 of japanned tin, with grooves to support a dozen plates; for quarter-plates the price is 1s. 6d., half-plates, 2s. 6d.

The Note Book is a small pocket-book designed for making notes of exposures, etc., and should invariably accompany the amateur on his excursions with camera and lens. Messrs. Piper and Carter, 5, *Castle Street, Holborn, E.C.*, publish a useful one which includes tables for facilitating exposures by W. K. Burton, in paper covers, free 10d., or in cloth, 1s. 1d. post free; the amateur should buy the latter as he will eventually find it an invaluable friend and a very useful book of reference.

Two things are yet essential: a fine day and a subject to photograph. With respect to the latter, the beginner should avoid portraiture until he is satisfied he can make a perfect negative, or he and his productions will certainly be held up to ridicule by his friends, and in return for his trouble (and failure) his workmanship will receive the sarcastic criticism of his "sitter." The beginner should devote himself to "still-life" until fairly proficient, and for this reason landscape photography perhaps forms the best subject. I think I need scarcely say it is not advisable the amateur should go any great distance from home to make his first exposures, as the first dozen plates exposed will almost invariably prove failures; it is equally unnecessary to say that plates not larger than quarter size should be used at first, as it is simply a waste of money using a larger size when imperfect results are inevitable.

We will now suppose the desired fine day (which need not necessarily be a *sunny* day) has arrived, and we have previously selected the view or views we wish to take.

With the dark slides we enter the dark room, and having closed the door and drawn the curtain, we examine carefully the walls, door, etc., to see if any white light gains an entrance; if any is discovered it must, of course, be stopped out before proceeding further, and the proper media fixed over the window. By this time our eyes will have become accustomed to the semi-darkness; a dark slide is opened ready for the reception of the plates, which are generally packed in packets of four, and kept from rubbing together by strips of thin cardboard inserted along the edges, and pieces of tissue paper laid between the films; they are next wrapped in thin ruby coloured paper, next in thin brown paper, the three packets are then packed together in stout brown paper, and lastly, placed in a cardboard box, which is also secured with an outer wrapper. The lid is taken off the box and the top packet of plates opened, care being observed that its contents are not exposed to even the non-actinic light longer than is absolutely necessary. The plates have a milky white appearance, not unlike opal glass; they must be handled very carefully *by the edges:* the film side of the glass must on no account be touched with the fingers or a stain will probably ensue. The side bearing the sensitive film can be distinguished by its matt surface, while, if held near the window the glass side reflects the light. Lightly dust the film with the broad camel-hair brush (these dust brushes should be 2 or 3 inches wide and cost about 2s.), and lay the plate *film side downwards* in the slide;

over the plate lay the metal division with the spring resting on the back of the plate, and on the top of this the next plate, *film side upwards*, secure the plate with the turn buttons (if the slide is of book form this is unnecessary) and close the side, fastening it at the outside with the hooks. Remember the plates must always be *back to back* or film sides outwards. Now enter in your note-book the numbers of each slide filled, and, if half and quarter-plates are used, the size of the plate opposite each number, or you may afterwards discover to your infinite delight (?) that you have taken a half-plate picture on a quarter-plate and *vice versa*. See that the remaining plates are properly wrapped up, the lid placed firmly on the box and secured by an elastic band, or (what is preferable) transfer the lot to a plate box.

The apparatus must be examined to see if everything is in working order, and packed, marking off on a list, previously made out and attached to the lid inside the case, each separate article as it is placed in the case; the day's pleasure is *somewhat* marred on discovering, when ten or fifteen miles from home, that the tripod screw has been forgotten, or the lens diaphragms have been left behind.

Arrived near the scene we wish to portray, before unpacking the apparatus, the light and also the point from which the view is shown at its best must be carefully studied. The amateur must not forget for a single moment that *he* is the artist, and that *he*, with the aid of the camera and lens, and not the camera and lens by themselves, is about to make the picture; and he should also bear in mind that there is almost as much scope for showing his artistic taste as if he were about to paint the picture on canvas instead of on the sensitive plate. We will first consider the light. In most landscapes sunlight greatly improves the effects, changing the view from a flat, tame, and death-like outline, to a picture sparkling with light and shade, and glowing with life. The lens must never be directed against the light (*i.e.*, the source of light must not be behind the view to be taken), nor should the light be directly behind the camera, as the result, in that case, would be excessively flat—all light and no shadow. The best results are procured when the light is a little to one side of the operator. It is evident, then, that some views will be "lighted" best in the early morning, while for others the light will come in the desired direction at mid-day, yet, again, others appear at their best with an evening light. If it is possible, the photographer should decide, previous to his bringing the apparatus, at what part of the day the view will be lighted, so as to give the most satisfactory result. Half a hour spent the day before in examining the scene from various points, and deciding at what time the light will be in the right direction for exposing the plate or plates, will be well expended, and save the photographer a large amount of trouble the following day, when the apparatus is brought into the field.

Many of the artistic qualities of the picture are attained in choosing the point of view for taking the photograph, and a few yards to the right or left will sometimes make an enormous difference in the result. The introduction of a stream of water always gives the picture a charming effect; straight parallel lines should be avoided, and, if any appear, should be broken by the addition of some object or figure—as a cow, wheelbarrow, tree trunk or branch; balance can also be adjusted by placing a figure in the mid-distance. The amateur should study Mr. H. P. Robinson's excellent work on "Pictorial Effect in Photography," especially Chapters VIII., IX., and X.; a cheap edition is published by Piper and Carter, at 2s. 6d.; and should be in the hands of everyone who desires to become an *artist* photographer.

We may now unpack our apparatus. The tripod must first be fixed up; the legs are extended and planted firmly on the ground, one leg being pointed directly at the object to be photographed; the camera is next screwed to the tripod and erected. Before the lens is attached to the front of the camera the glasses must be carefully wiped with a chamois leather * or soft silk handkerchief to remove any particles of dirt or dust that may adhere to them. We must now decide whether the vlew is to be taken vertical or horizontal, and adjust the reversing frame (or, if the camera is not fitted with this useful arrangement, the camera itself must be turned) accordingly. Lake scenes and broad open landscapes should be taken on a horizontal plate, while, on the other hand, wood scenes, avenues of trees, and the like, are best taken on a vertical plate. It is a very simple matter, however, if the picture does not satisfy us when shown on the ground glass in one position, to turn the reversible frame—or the camera—as required. If the camera is perfectly rigid and everything secure we can proceed

To Focus.—Throw the focussing cloth over the head and a few inches over the camera, holding the ends together underneath the camera, so as to exclude all the light, with the exception of that which enters through the lens. As is the case with most people, the beginner will probably at first see nothing but the reflection of his own face in the ground glass; this is because he is looking at the *ground glass*, and not at the *view* shown upon it, and invariably he has his face much too near the glass. To examine the pic-

* Chamois leathers, prepared for the purpose, can be obtained from the dealers, price about 1s. or 1s. 6d. each.

ture properly the eyes of the operator should be about the same distance from the focussing screen as the length of focus, *i.e.*, if the distance from the lens to the ground glass be 8 inches, the distance between the photographer's eyes and the ground glass should be the same. The view will probably appear "fuzzy," indistinct, and "out of focus," and will, of course, be shown on the ground glass inverted or upside down. If the picture, as shown on the glass, is too large, the apparatus must be taken backwards until it is reduced to the desired size; if it is too small, the camera must be advanced in a like manner. The object should not fill the whole of the glass, as a margin is cut away all round afterwards, when "trimming" the prints. A simple and permanent method of showing on the ground glass the size the photograph will be when finished, is to take the cutting shape used for trimming the prints, and having placed it in the centre of the focussing screen on the ground (rough) side, run a pencil round the edges of the shape; the picture filling this square on the glass will represent the finished picture. The next procedure is to get the picture into the right position on the plate. Sbould the picture contain any straight vertical lines—a building, for instance—great care must be taken that the camera is perfectly level, and the vertical lines parallel with the upright sides of the plate, or the building will appear to be intoxicated, and falling out of the picture. When a single lens is being used, buildings, or any object with straight parallel lines should, if possible, be brought into the centre of the picture, so as to obviate distortion to some extent. The horizon line should be about one-third (rather more that less) way from the top of the picture; if the view on the ground glass does not include this amount of sky, the camera can be tilted up, if the subject be a *simple* landscape, which does not include any buildings, by drawing the front leg of the stand a few inches backwards, or, if too much sky is introduced into the picture, the front leg may be advanced a few inches. If, however, the picture be composed of straight vertical lines, the swing back must be brought into use. To focus, insert the largest stop (open aperture), and work the body of the camera backwards and forwards until the principal object, which should be near the centre, appears sharp, clear, and "crisp." The foreground and distance, and perhaps all the picture near the edges of the glass, will yet be out of focus; this is overcome by inserting in place of the largest stop the next size smaller. If the foreground and distance are still considerably out of focus, replace the last by a stop still smaller, until everything is fairly sharp, remembering that, at the same time, whenever a smaller stop is used the view will require about *twice* the length of exposure as it would with a stop a size larger. When animate objects form part of the picture, or when there is a strong wind continually disturbing the foliage, this is a serious consideration. Now fold back the focussing screen, and place the cap firmly in its place on the hood of the lens. The slide containing plates Nos. 1 and 2 is taken from the case, and, without exposing it longer than can be helped to the sun, it is placed in the groove at the camera back in a position for exposing No. 1, the shutter marked No. 2 being visible to the operator. Before proceeding any further, enter in the note-book the name of the subject you are about to expose the plate on. This seeming triviality may, not once, but many times, preclude you making the unredeemable blunder of *exposing two pictures on one plate.* The focussing cloth is next laid over the back of the camera and dark slide, and No. 1 shutter is gently withdrawn, the operator's right hand being under the cloth, his left at the same time holding the slide in position from the outside.

FIG. 24.—MARION'S PLATE BOX.

FIG. 23.—CAMEL HAIR DUST BRUSH.

Exposure.—Few fixed rules can be laid down as to exposure, so many different things have to be taken into consideration; the intensity or quality of the light, the time of day and year, the size of stop, the rapidity of the plate and lens, all contribute largely to make any fixed law for exposure an impossibility. The objects requiring the least exposure are sea and sky bits, the clouds, water, etc., reflect the light, and thus are very active. Next comes broad, open landscape pictures, then landscapes overhung with foliage, outdoor portraits in a bright, diffused light, portraits in ordinary rooms where the subject is placed near the window; and, lastly, interiors—ordinary living houses requiring from ten to fifty times longer exposure than interiors of churches, etc. To find the exact exposure, a useful and instructive experiment may be made as follows:—Draw out the shutter so as to uncover the plate one inch, and expose for exactly one second; on the cap being replaced on the lens, the shutter is drawn out another

inch and the plate exposed for another second; this must be repeated until the whole of the plate has been exposed—say, four exposures. The first will have received four seconds; the next, three; the next, two; and the last, one second. Develope the plate in a nominal solution, and the division of the plate that produces the best result must have received the proper exposure. Several forms of "Actiometers" and "Sensitometers" are sold for testing the rapidity of the plate, measuring the sensitiveness of the light and indicating the length of exposure required. As I have never used any of these inventions in actual work, I cannot speak as to their worth, but I hardly think they can be of much value to amateur photographers. Assuming we have the present time of year, with a bright diffused light or *weak* sunlight, early in the afternoon, a plate of ordinary rapidity (Ilford plates are about twenty times quicker than wet collodion), a rapid rectilinear lens with medium stop, and a landscape with a fair amount of foliage in the mid-distance, an exposure of about three seconds may be given. With short exposures it is necessary to count the seconds orally or mentally; exposures of over eight or ten seconds may be timed by the watch. Remove the cap from the lens gently, so as not to shake the camera, and hold it a few inches beneath the lens, so that it may be immediately replaced on the conclusion of the exposure.

Shut the slide, and before removing it from the camera back, jot down in the note-book the particulars relating to time, exposure, stop, etc., under their respective headings. The dark slide is withdrawn from the camera, the apparatus taken down and replaced in the case, and our operations in the field (for that view, at all events) are concluded.

I here give a list of relative exposures required by different subjects, everything else being under exactly the same conditions. Sea and sky views require the least exposure, and taking this as unity, the approximate exposures of other subjects will be as follows:—

Sea and sky	1 sec.
Open landscapes	3½ „
Landscape with foliage in foreground	16 „
Groups and the like, out of doors	20 „
Out-door portraits	25 „
Portraits in well lighted studio or conservatory	100 „
Architectural subjects in foreground	2 min.
Portraits near window in ordinary room	3 „
Beneath Trees	4 „
Interior	from 25 minutes to 6 hours.

The Use of the Rising Front and Swing Back.—If, in architectural and other subjects, which are composed to some extent of straight vertical lines, the camera were tilted or tipped up to include a point at some height—the top of a building for instance—distortion would ensue, the straight parallel lines would converge, and the building would appear as if falling backwards. This defect not being so palapable in landscapes of the simplest composition, the camera may be tipped without much fear of distortion being perceptible in the finished picture. When, however, architectural objects form the principal part of the picture, the back of the camera must *always* be *perpendicular*, or parallel to the vertical lines of the picture. There are two methods, either of which may be employed, to overcome the difficulty. The rising front or the swing back may be used, but each, unless special care be observed, show their imperfections. Perhaps the best course to adopt is to raise the camera front and lens, if too little of the top of the subject be shown on the ground glass. Here, again, another difficulty confronts us; unless the lens be a very good one, and capable of covering a surface larger than the plate to be exposed, the light will be cut off from the bottom of the plate if the lens is raised to any extent. When the swing back is employed the camera is tipped as required, and the ground glass adjusted to the vertical plane by means of the swing back. When the lens will cover sufficiently, and the rising front permits of its being raised high enough, the former method should certainly be adopted, as the use of the swing back necessitates the employment of a very small stop and consequent prolongation of the exposure. In subjects where it is desired to convey the idea of steepness or height—a high mountain, for example—the rising front alone should be used, and not the swing back, or the result would be to dwarf the subject, making it look much less than it really is. Another purpose for which the swing back is used, is to bring points at different planes to a focus on the ground glass at the same time. The view being shown on the glass in an inverted position, the lower, or foreground of the picture is thrown by the lens on the top of the ground glass, and the upper is at the bottom. Now if the upper, or distance portion of the picture were in sharp focus, unless a very small stop were used, the foreground and middle distance would be more or less indistinct. To bring the foreground into sharp focus, the camera would have to be extended to remove the ground glass further away from the lens, when, of course, the distance would be out of focus. If, however, the top of the ground glass is swung further from the lens than the bottom, all the parts of the picture are brought into focus at once, thus obviating the use of a small stop. The correct amount of swing the camera back must receive to

bring all points into focus can be ascertained by trial only. The *side* swing is used for a similar purpose: to bring objects nearer the camera at one side of the view to the same focus as distant objects on the other side.

I must defer the process of development till the next paper; and will conclude the present chapter with a few aphorisms relating to out-door photography.

When focussing, remember that the nearer the camera is to the subject the further away must the ground glass be from the lens; and *vice versa*.

Always endeavour to shade the lens as much as possible, and the resulting picture will have its brilliancy proportionally augmented. Many landscape artists use a large cone-shaped hood on the lens, for this purpose.

On a hot summer day the atmosphere is often hazy and highly charged with non-actinic light, while after—or even during—a shower of rain the atmosphere is clear and bright.

Prolongation of the exposure is required during a strong wind, especially during an east wind, when double the usual exposure should be given.

Give your plates *full* exposure; over exposure is more easily corrected in the developer than is under exposure.

Clouds, being eight or ten times more actinic than the rest of the picture, will be proportionately over exposed, and unless they receive much less exposure than the foreground (which may be attained by the use of a drop shutter) they will appear in the finished picture as a blank space. They may, however, be afterwards "printed in" from a separate negative by what is termed "combination printing."

The colour of the object is a great factor in the exposure required: whites and blues are rapid; red, brown, yellow, etc., are slow according to their actinism.

Buildings taken full front elevation *never* look well; the camera should be placed in a position to include the front and one side, showing the building in perspective.

When the two sides of a picture are very similar (as in a street scene, for example) symmetry should generally be avoided. By placing the camera a little to one side, and pointing the lens at the other, the *facsimile* of the sides may be subdued.

Aim at the *quality* rather than the *quantity* of the views taken.

Remember that photography, being a witness, needs to be treated with much judgment lest it tells lies. Also that those who use the most art betray the least. And lastly, never go forth without a large reserve of patience as it is sure to be needed.

(*To be continued.*)

PRACTICAL SCENE-PAINTING FOR AMATEURS.

By HENRY L. BENWELL.

XIV.—TYPICAL SCENES (*continued*)—FOREIGN SCENERY.—A MARKET PLACE.

IN taking up the painting of foreign scenes, an entirely new departure must be taken. The painter will have to study carefully the effects of climate, air, light, etc., on the surrounding objects as they are represented in nature in all four quarters of the globe. The colouring must therefore be different in almost every case. There is no doubt, that eastern or oriental scenes produce the most successful and picturesque effects when painted by a master hand, and are, therefore, probably the favourite subjects in this line, with professional artists. It is for this reason, that two designs of this class accompany the present chapter. In all paintings after this style the young artist must not forget to give increased brilliancy to his colours, increased distinctness to distant objects, also to use a fresh scale of light, shadow, and reflected lights. All this calls for the more rich and bright pigments occupying the first place on the palette—the most important being the siennas, chromes and lakes.

In the painting of foreign scenes, the artists must necessarily be "well up" in the architecture incidental to every country on the face of the earth, or at least, when he is about to paint any certain subject, to make a careful study of the scenery, etc., appertaining to the country or locality he intends to represent on the canvas. Of course, the inexperienced in matters such as the one now under discussion may often save themselves a large amount of time and money by making visits to the shop of the local printseller or artist's colourman, and hunting up an engraving or chromograph to suit his purpose, with perhaps little or no alteration as regards design.

The one object I have in view, is to impress on my readers the necessity of producing something faithful in all respects, so that their work when viewed by the audience, may not be too severly criticised by any art-loving friends who may happen to be present. I repeat, therefore, what I touched on in my introduction as regards architecture—viz., that the painter should possess at least some slight knowledge of all known styles—Romanesque Moorish, Greek, Oriental, etc. As regards landscape, it should be remembered that Swiss scenery is mountainous, whilst that of Holland is low meadow-land; then there is the backwoods of America, the vast tracts of bush and tropical climate of New Zealand; as a contrast to these, take Siberia for instance, with the snow-covered ground and

FIG. 77.—ORIENTAL LANDSCAPE, USEFUL FOR BURLESQUES OR FAIRY PIECES.

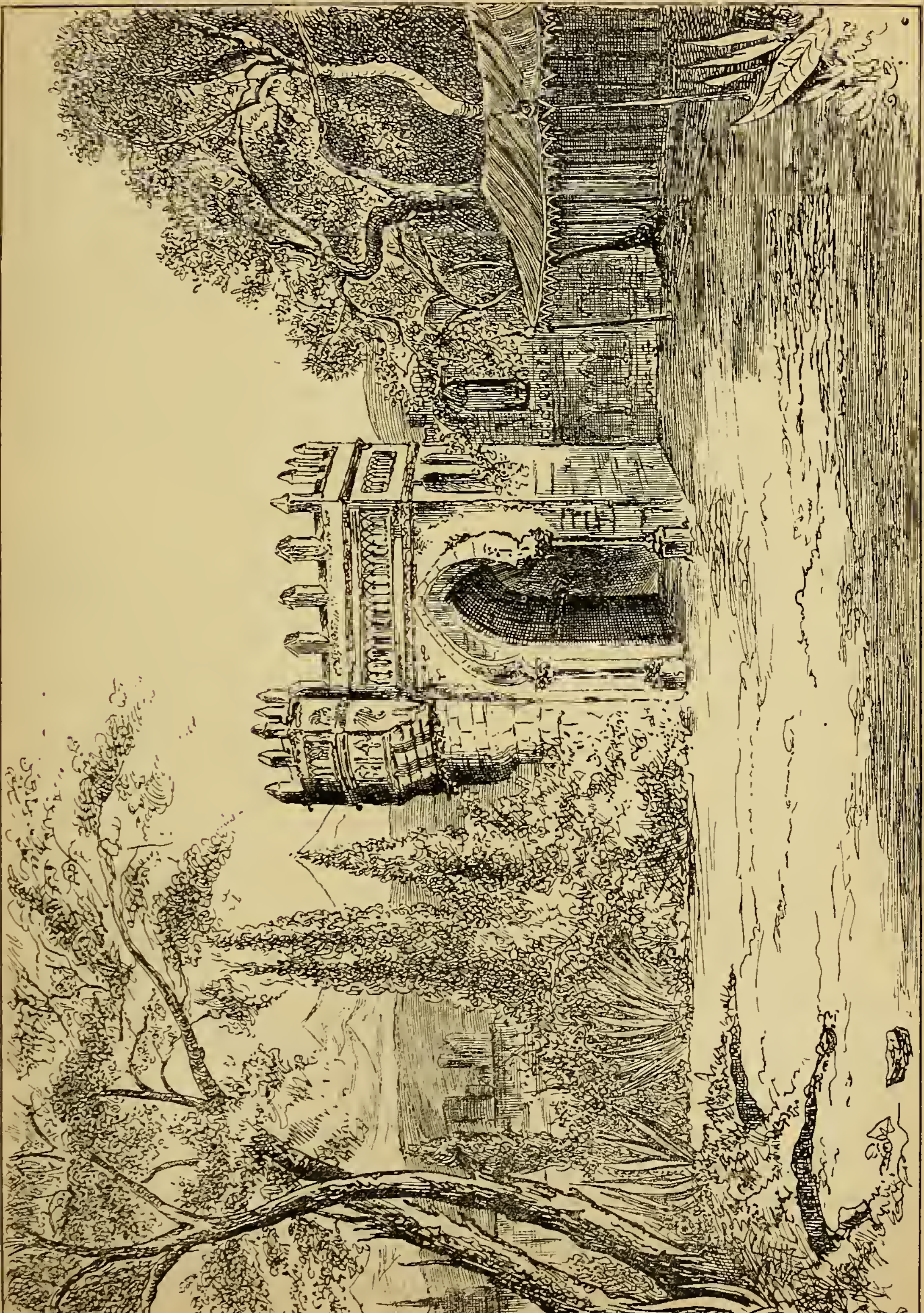


FIG. 78.—MOORISH TOWER AND GATEWAY, FROM SCENE IN GOUNOD'S "LE TRIBUT DE ZAMORA," AS PRODUCED AT HER MAJESTY'S THEATRE IN 1880.

intense red sky and setting sun, just such a picture as was represented at the "Prince's" Theatre in "Called Back." Not only the last, but the foregoing and many other subjects are nightly produced on the stage of the present day; hence it is, that I draw the reader's attention to these—what might otherwise appear unimportant facts. My remarks, however inadequately they may be written, in this and former chapters, will have, I trust, at least one effect on the aspiring scene-painter—that is, to set him thinking, and to make a study of this art, in the same way as any other art would be studied and learnt by a pupil. This, in my own small way, I have endeavoured for many years to do; and it is the study of the matter that has enabled me to pen these chapters and give to others the benefit of my slight experience in matters relating to the "Scenic World."

It is not sufficient for the scene-painter to be a mere copyist or a machine for laying the colours on the canvas—like too many of the old school now dying out, on the other hand, let him make a careful study of every picture before he transmits it to canvas and when at work, to take careful note of fresh ideas as experience teaches them.

Fig. 77 will be found a useful design in many plays, especially in burlesque or fairy pieces. Messrs. French publish a similar subject as an act drop, but with the addition of many draped figures in the foreground, their design may therefore be utilised with the figures as an act drop or without them as an ordinary "cloth." I do not myself care much for the subject as a "drop," but as a simple landscape it would make a really good typical scene. I have given it here, because a similar design as I have just said, may be had from French's in colour, which will help the most inexperienced to paint it more quickly than any written description on my part. The sky is composed of two tints—a mauve and lemon chrome—with the setting sun near the centre, the sides of the distant rocks are put in with a darker tint of the first sky colour, the tops being tinged with green; the foliage is laid in with Dutch pink and light green lake, the second painting being done with dark green lake, sienna and chrome. The trunks of the trees are painted sienna and vandyke brown. For the foreground, green lakes and chrome may be used. The colouring is very simple throughout, but is nevertheless effective.

The next subject (Fig. 78) is a sketch from a scene in Gounod's opera, *Le Tribut de Zamora*, which was played at Her Majesty's in 1881. Here is plenty of opportunity for effective colouring, commencing with a cloudless sky of azure blue. The distant mountains a darker tint, the hills and towers in the middle distance a purple, the water with the sky colour and shadows deeper. In the foreground the tower and gateway must be painted boldly, and the foliage contain some masses of bright green. The foreground may be of ochre or raw sienna, and shaded with burnt sienna and umber. For the other parts, the artist must paint according to judgment, or if a novice in colouring must experiment when getting out his coloured design. I have hitherto given detailed instructions as to colouring the designs and sketches which have already appeared; in the few that have to follow I shall not be quite so explicit, in order that the reader may learn to colour his "cloths" after his own ideas, and without relying on outside help. Fig. 78 in its original form was a set scene, and was arranged as follows. The distant mountains and middle distance composed the back cloth. The entrance tower was a built set piece, the foliage on its left was another set piece, and the trees and banks each side were the wings and raking pieces respectively. The sketch may be arranged as a "set" after this fashion or in a modified form, and again as a simple painting for a back cloth.

A Market Place is another useful subject, and makes a very good "stock" scene. In Fig. 79* most readers will readily detect something familiar to the eye, and no wonder, for the sketch depicts a part of "Old London" in the Exhibition grounds at South Kensington. It is one end of the broadest part of the street, and will make a very pretty scene when transferred to canvas. There will be abundant opportunity during the coming season to make a careful study—as to colouring, from the original. The young artist with the design on his sketching block in outline, can very quickly jot down on each part of the sketch the particular colour required, or, better still, he may go early in the day with his colour box and make a water colour drawing. However rough it may be, it will be of great use in painting his scene, and will be good practice in painting from nature. This remark reminds me that scenic artists often go out sketch-book in hand, and look out for some pretty piece of local scenery which they afterwards transfer to the canvas in the theatre, such work being invariably met with applause when recognized by the audience. Several scenes in the Birmingham pantomimes this last season were faithful reproductions of favourite local spots, and were generally admired. In my next chapter when treating on "Street" scenes, I shall give a sketch of "Old London" arranged differently and suitable

* It is desirable to give Mr. Benwell's sketches for scenes as full page engravings, in order to render them as useful as possible to the readers of this magazine. It is difficult to allot to the illustration of any single paper or chapter space exceeding two full pages. I am therefore compelled to postpone the appearance of Fig. 79 until next month.—ED.

for a *back cloth.* I have made a sketch of a "Village Green," and had intended to give it in this chapter, but space, I regret to find, prohibits its appearance after all. I may add, however, that I am giving as many typical designs as possible, as, if I may judge from the correspondence which reaches me, the principal difficulty with amateurs is the proper selection of subjects for painting and where to obtain them. I trust that the arrangements for supplying to readers of AMATEUR WORK a series of specially-executed coloured designs by a clever professional artist, as announced in "Amateurs in Council," page 331 of this volume, which see, will afford a satisfactory answer to these enquiries.

(*To be continued.*)

THE WIMSHURST INDUCTION MACHINE.

By O. BECKERLEGGE.

(*For Illustrations see Folding Sheet issued with this Part.*)

IN Vol. V., page 49, I gave details of a cheap electric machine of the old type, and made a remark or two in reference to the Wimshurst machine. In the article referred to, I catered for the most inexperienced of electrical readers. I now propose to write for those who are somewhat advanced. The Wimshurst is essentially an induction machine as the electricity is not the result of friction as in those of the cylinder form—but "induced" on the principle of the electrophorus. All those who have gone very far in the study of electricity, know that there is, for example, a great difference in the *conditions* of the primary and secondary current in a Rhumkorf coil. Owing to chemical action in the cell a current is set up in the primary coil; but when this is surrounded by another coil under given conditions, a secondary current is set up, which in its character is very different to the primary.

The first, for example, might not be able to leap across a hundredth part of an inch, but might at the same time produce great chemical or mechanical change, whilst the induced current will produce little if any chemical change, but will give the most violent physical shock, and has such intensity that it can leap over a space in air, perhaps a hundred times greater than the primary.

My purpose will be simply to give such instruction as shall enable the intelligent worker to produce for himself the machine, but not to give any theory, as to the mode of induction. Indeed, it is a subject so far, hid in great mystery. The inventor himself, I think, is hardly sure, and by the various theories given, one is led to the conclusion that the problem is unsolved. But one may naturally ask, seeing there are already the Rhumkorf coil and the Winter frictional machine, both of which are capable of producing electricity of high tension, what is the advantage of the Wimshurst over these?

In the first place, although we cannot conceive of anything more compact and beautiful than the coil, unique in some sense, yet all who have worked on one, know how great is the difficulty in making a large one. There are but very few comparatively, who have succeeded in making one to give a spark more than 1 or 2 inches in length, and the difficulty increases at a rapid ratio with every additional length of spark; and then as to cost, as no one can expect to get more than an inch from a mile of wire, it will be seen that the cost is considerable.

In reference to the plate or cylinder machine, the great drawback is that the state of the atmosphere affects it so readily. If the least moisture in a warm room condenses on the plate it is fatal to all success.

The advantage of the Wimshurst machine is, that in contrast to the Rhumkorf, both in money and labour, it costs only a fraction; and in reference to the ordinary plate machine it gives with the same size plate a much longer and more rapid discharge, and practically is indifferent to climatic conditions. Now having said so much to inspire the learner with the requisite enthusiasm, we will proceed to our work.

The essential parts of the machine are as follows; —1. A bed or stand. 2. Two glass discs. 3. Driving wheels for rotating discs. 4. Condensers with combs and dischargers. 5. Neutralizing brushes and rods. I have given three views of the machine, viz., side elevation, end elevation, and plan as seen from the top. The letters refer to the same parts in each Fig. The bed may be made of good pine but will be far more satisfactory if made of mahogany. For the ends take two pieces, 12 by 4 by 1 inch; sides two pieces, 18 by 2 by 1 inch. At each end of the side-pieces cut a tenon 1 inch long and 1 inch wide and ½ inch thick. Mortise them into the ends, when we shall have a frame 2 feet by 1, by 1 inch thick. Care must be taken that the mortising is done truly, and in a workmanlike manner, else when put together the sides will not be true with each other. If when glued up two of the corners are cockled, and do not lie true with the other two, if it is only slight, with a plane take off what is necessary from the opposite corners, then turn the bed over and take off as much as is needed from the corresponding corners; by this means if there is only a slight twist your work may be made quite true.

If you are a novice at wood work let me say do nothing by guess. When your sides and ends are

properly squared up, mark your tenons and mortise with a gauge, leaving your pencil mark in the wood, not cut away, you will then have a tight-fitting joint. If your sides are of the same length between the tenons when put together, the frame will be perfectly square at the angles. When we have gone so far we can round off the sharp edge of what will be the top of the bed.

We now require two standards to carry the discs. For this purpose we shall require two pieces of wood, 10 by 6 by 1 inch; plane up and square one side and end; 1 inch from the end draw a line for tenon, and square with this a central line; you must now taper the standards from the foot to the top, the central line will enable you to get the taper true; Fig. 1, B, will show you a desirable shape. Cut two tenons in the foot as shown by the dotted lines. The top should be rounded off as well as the edges. Draw a line across the centre of the sides of the bed, put the standards perpendicular to the bed with the central line true with line drawn, and mark where the tenons are to be mortised in, 8½ inches from the foot bore a ½ inch hole in each standard. Before gluing the standards in their place, see that they are perfectly true with each other, and that a rod passed through the holes will appear true with the bed when casting the eye over it. When your work is satisfactory, it can be glued together.

Out of ½ inch wood we must make eight pieces for bracket feet of somewhat triangular form, the precise form will be a matter of taste. Four of them must be ½ inch narrower than the others. When joined at right angles to the others, the thickness of the wood will make up the deficiency. Care must be taken that these are perfectly square. If the edges are true good glue will be sufficient to join them, if any doubts exist as to the strength of the joint, then with a ¼ inch centre bit bore a hole ¼ inch deep, put in a screw and then plug the hole with a plug, cut with the grain running the same way with the brackets. When the brackets are perfectly true and ready for fixing, take the under side of the bed and gauge a line ½ inch from the edge along the four corners, ends, and sides, with a compass mark off a point on the top of each bracket, and a corresponding mark from the gauged line in the bed, with a centre bit bore ¼ inch hole, prepare eight dowel pins, and with these and glue, fix your brackets in their place, see dotted lines, Figs. 1 and 2. If your work is done properly, the bed will hang over the feet ½ inch which will give a finished appearance to it. By an oversight I have not so shown it in the elevation, but marked the brackets flush with the bed, but the plan indicated will make a more finished job.

One inch from the centre of each end, two holes must be bored or cut ⅛ inch larger than the glass jars, which we will suppose are 2 inches in diameter, the jars, of course, must be procured first. You must now prepare two pieces 11 by 3½ by 1 inch to form shelves on which the jars must rest. Glue cleats on the inside of each bracket so that the shelves resting on them shall be 1 inch from the bottom. When this is done, place the shelves in position, mark where the brackets come and cut out a piece in the shelf so that it shall come flush with the brackets. Before the shelves are fixed in their places, two cavities must be made in them the same size as the holes in the bed, but not more than about ½ inch deep; these are for the purpose of giving stability to the jars and also for another purpose to be referred to further on.

Perhaps some difficulty may be experienced in making the holes, as it is not likely the amateur will have a centre bit the size.

Proceed thus:—With a compass mark out the hole required, then with the largest centre bit you have bore a ring of holes nearly up to the margin of the circle, the holes can then be completed with a gouge and rasp. The cells in the shelves can be worked out in the same way. The bottoms levelled by a chisel. When everything is done so far to your satisfaction glue a bit of velvet on the edge of the holes and cells so that the wood shall not scratch the foil on the jars. We will now proceed with the driving wheels. Procure two pieces of mahogany 7 inches square and, say, ¾ or 1 inch thick—these must be turned in a lathe with a centre hole, say 2 inches in diameter, and with a groove in the circumference for the driving belt. Now procure a length of round iron or steel, ½ inch rod and 14 inches long, file the ends perfectly true and make a centre punch mark in each end in the exact centre. Next take two pieces of wood, say 4 inches long and 2½ inches in diameter, bore a central hole in each longitudinally large enough to admit the rod, but they must drive on tight. Let the rod project 2 inches at one end, 4 inches at the other, the two pieces will thus meet.

Turn them down till they will permit the driving wheels being driven on tight. Cut away ½ inch of each piece in the centre, leaving 1 inch of the rod clear, also turn the other end off with a bead or in any other way to make a nice finish. When turned and completed lay it across the bed, the short projecting end of the rod being flush with the bed; the driving wheels should then be about 2½ inches from each side of the frame or bed. If they do not stand at the same distance they must be shifted until they do. The longest end of the rod should now be either screwed or squared off to receive a crank handle. Exactly in the centre under the standards two bearings, either of wood or brass, as shown in Fig. 1, must be screwed for

the driving wheels to run in. Fig. 4 gives a reduced view of driving wheels. We now require bosses to fix the glass discs in their place.

For this purpose we shall need two pieces of mahogany $4\frac{1}{2}$ by 3 inches. But, first of all, we shall have to deal with a spindle for the same ; for this purpose we shall require a steel rod 18 inches long and $\frac{3}{8}$ inch in diameter, this must be perfectly true. We must also procure 6 inches of brass tubing, large enough to admit the rod easily, but not with much shake ; cut it into four equal pieces. Now bore a centre hole through the length of each piece of mahogany so as to admit the brass tube being driven in perfectly tight; these brasses will form bushes in the bosses to run on the steel bearing just referred to. Turn the bosses on a mandrel to a shape as shown, Fig. 5. At one end there will be a disc to receive the plate of glass with a nipple 1 inch in diameter and $\frac{1}{4}$ inch deep. We will suppose that the exact distance between the standards to carry the glass plates is 9 inches, then the combined length of these two bosses must be just $\frac{1}{16}$ inch less. Measure the position of the groove in the driving wheels, and in an exactly corresponding position a groove must be turned in the bosses to receive the driving bands. Now pass the spindle through the standards and bosses as shown, put a band on each and the corresponding driving wheel; one band direct, the other crossed, and we shall be able to drive the discs in an opposite direction at a uniform speed.

Now for our glass discs. Of course, these can be bought with ground edges and with central hole, but we think with a little care we may be able to either make them or get them of a local glazier. First of all, cut a pattern 18 inches in diameter in thick cardboard of twelve sheet, such as is used for cutting picture mounts. Cut the central hole a trifle, say $\frac{1}{8}$ inch larger than the hole in the glass is to be ; take this to a glazier and get him to select a sheet of glass perfectly flat if he has it, if not, as near flat as possible. It should be the thinnest he has, not more than $\frac{1}{16}$ inch thick, and white ; this last point must not be overlooked as the white kinds are less disposed to conduct electricity ; some of the green kinds of glass can hardly be electrified. Mr. Wimshurst has given a simple test to discover if the glass is of the right quality. Take a light body, such as a feather or small bit of paper, and fasten it to a silk thread. Now warm the glass and rub it with a silk handkerchief, if the glass is all right the bit of paper will vigorously fly and adhere to the glass if brought near to it ; if, on the other hand, the glass will not attract the body when brought, say within an inch or two, the disc is useless for our purpose. But before we condemn it we should be sure that the glass is dry ; this can be easily assured by warming it before the fire. With the template of cardboard laid on the glass the glazier will find no difficulty in cutting a perfectly round disc. Should you attempt to do it yourself, turn the glass over and run the diamond across the four corners so as to intersect the circle. If you are not very sure of your cut, either tap along the cut on the opposite side so as to complete the fracture, or take a piece of hot iron and run around, a crack will follow the heat.

Now to make central hole. There are two modes, either of which we can adopt. The first is to cut a small circle by the aid of the template, and then to make cuts across at several diameters, and by one of the modes just indicated make a fracture through the glass ; lay the glass on a flat tube with a smooth cloth under it, and then with a sharp point, the point of a scissors will do, tap away in a small circle until you make a hole, and then gradually take away the glass bit by bit. I have seen a round hole made in the side of a glass bottle by the point of a scissors alone without any previous cutting, and done quickly too ; but I do not think I have ever seen it recommended in any article.

There is another plan which I have recently seen recommended, which is, undoubtedly, a good one if many discs are to be perforated, but a good bit of trouble if only a couple of plates are to be made : Place the plate on a flat table, over it fix a frame with two wide bars, one above the other, a hole must be bored in each bar an inch in diameter and directly perpendicular to each other. A copper tube is now taken of a diameter to move easily in the inch holes, one end of it must be beaten up with a hammer so that the diameter shall be slightly increased, by this means it will clear itself when going through the glass. Fix the glass on the table so that the tube shall come exactly in the centre, pour emery and water, not too thin, down the tube, and make the tube revolve with a drill fiddle-bow; the tube should be weighted with a ring of lead to keep it hard on the glass ; by this means a hole is expeditiously cut in the disc. Although I have not tried it I have no doubt it is an efficient means where large numbers are required, but for the amateur, who, perhaps, only requires a pair of plates, the first plan I have recommended is the cheaper.

If there is any slight hollow in the discs then let the concave sides be next each other. They must now be fixed to the bosses, any of the ordinary cements prepared for mending glass and china will do. See that the cement is very thin, with heat, also warm the boss and the discs, but be careful of the latter that you do not crack it with the heat. Now quickly cover the face of the boss with the cement, and place a ring of it around the hole in the disc. You

will need someone to help you; gently but firmly press the disc up to the boss, being careful that it is set perfectly true and at right angles with the spindle. Before it is set pass the spindle through it and the standards, and by steadily and slowly revolving it you will be able to fix it perfectly square. When one is set then do the same by the other.

The centre of the boss will come through, say, about $\frac{1}{8}$ inch. See to it that the brass bush is hardly level with the boss, but just within. If everything is just as it should be, when the spindle is put in its place the discs will revolve just $\frac{1}{4}$ inch apart and touch at no point. The nearer they can come without coming in contact the better.

As a further precaution against the possibility of the discs coming off, two thin rings of ebonite, with the hole made to fit tightly on the end of the bosses, may be cemented to the bosses and discs; but if proper care has been taken in making the bosses with a perfectly flat surface, and that there is perfect contact between them and the glass, with cement between, there is but little danger of the discs coming off.

The sectors of tinfoil must now claim our attention. As a matter of fact, it will be best to attend to them before the discs are cemented to their bosses. On the cardboard which we have used as a template, mark off an equal number of lines, say 20, these must be marked off with a compass at exactly the same distance apart. I may explain why there must be even numbers and not odd, as 19 or 25. If odd, there would be no two exactly opposite, but as the neutralizing brushes must touch two exactly at the same time, they must go in opposite pairs. Now take some tinfoil and cut out a number of wedge-shape pieces, according to the number of lines for the two discs. If you have 20 lines on each disc then you must prepare 40 segments. They should be $3\frac{1}{4}$ inches long, $\frac{3}{4}$ wide at one end, and $\frac{1}{4}$ at the other; let the ends be rounded off. Put your pattern with the lines drawn in it on a flat surface, and your glass disc on it, and with strong shellac cement fix the segments of foil to the glass; let the centre of each segment fall on the line; let the head of the segment be placed $\frac{1}{2}$ inch from the edge of the disc. See to it that no air bubbles are under the foil, but that it is in contact all over with the glass. One thing must be guarded against: be sure that no sharp point of foil is left on the edge, and that no corner is left sticking up, if so, the point will serve the purpose of a lightning conductor, and conduct your electricity away into space. Indeed, I would say now, and once for all, that there must not be the least sharp edge or point to any of our metal fittings, for, according to a well-known law of electricity, a sharp point will conduct away electricity, insensibly; for this reason and not for mere ornament it is necessary that all metal rods, etc., must terminate as spheres.

It will be best if now at this stage the discs are coated with shellac varnish, and dried quickly in a warm room or before a fire. Care must be taken that a portion of the tinfoil sectors be left unvarnished at the point where the brushes touch. As an additional precaution give each end of the sectors an additional coat of varnish. We must next provide five brass knobs or balls, about $1\frac{1}{2}$ inch diameter. Door knobs might easily be adapted for the purpose, by filing or turning away the sharp edge of the shank.

Take two pieces of tubing the same size as that used for bushing the bosses carrying the plates, and 4 inches long. In two of the balls bore a hole to receive one of the tubes; solder them in position, leaving, say $3\frac{1}{2}$ inches projecting. A $\frac{1}{4}$ inch hole must be drilled either through the knob, as shown in Figs. 1 and 2, or through the tube. Take two pieces of $\frac{1}{4}$ inch brass wire or rod of a sufficient length to come, when passed through the ball, and bent either at right angles or in a curve as shown, to within $\frac{1}{2}$ inch of the plates, over the point where the sectors are left free from shellac. The tubes carrying balls and rods are now placed in the standards, fitting tightly, at the same time receiving the ends of the spindle carrying the plate. By this means we shall be able to turn the neutralizing rods in any direction. The ends of the rods must have a hole bored to receive the brush, say $\frac{1}{2}$ inch deep, after which the ends must be rounded. Procure a small quantity of gilt wire such as is used by lace-makers—almost any philosophical instrument-maker will keep it now, I suppose—wind ten laps around a carving-knife, and cut one edge. Carefully twist the double ends together, and push them in the ends of the rods, and fasten them by a small peg of wood; four of these brushes will be required. Make all the wires straight, and cut to the same length. Put the rods in their place and secure neatly by a touch of solder.

When these are finished satisfactorily, turn the knobs around till the rods stand in the position indicated. The exact position will have to be determined by experiment; but, as a good guide, I would give the following plan: Supposing there are twenty sectors on each plate, bring a sector at the top to stand perpendicular, then turn the front rod so that the top end stands to the left, midway between second and third sectors, turn the machine around, and place the other neutralizing rod in a similar position. They will thus cross each other at an acute angle; but by experiment you will have to determine the exact angle.

We have next to consider the Leyden jars. We will take for granted that they are 10 inches high by

2 inches in diameter. Of course, these measurements are not absolute. Take a piece of foil 6 by 4 inches, smooth out all creases, cover one side with strong paste or shellac cement, and line the inside of the jar with it, bringing it within 6 inches of the top; cut out a circular piece for the bottom inside; coat the outside in the same way, bringing the foil to a level with the inside. We now require four discs of tin plate of a size to go into the circular recesses in the shelf. In the centre of each solder an inch or two of copper wire—bell wire will do—make a small hole in the centre of the recess, and pass the wire through, bring the two wires in contact, and solder them: do this to each end. Now solder a long piece of wire to one end, and lead the wire along under the bed, where it will not be seen; to the other end, and solder as before. The wire can be kept in position by small staples, such as are used in fixing wire fencing. You will see that by this means the outer coating of the four jars are brought into one circuit when they are in position. Four wood bungs or caps must be turned to fit the jars, Fig. 1, F. Take four pieces of ½ inch tubing, 6 inches long, bore a hole in each of four 1½ inch knobs large enough to admit the tube, push the tube in until it touches the opposite side of the knob. At this point, the exact diameter of the first hole, drill another ¼ inch hole in two of the knobs: these are to receive the discharging rods. For these you must take two lengths of brass rod, of a size to fit the tubes in the knob—say ¼ inch. These rods must be long enough to bend at a right angle, as shown in Fig. 1, K, and to go through the ball—a handle, as M, will admit its being turned in any direction. Solder a small ring on the rod at E: this will keep it at its proper height. The end of each rod at K must be cut with a thread to receive a ball, one 1½ and the other ½ inch diameter.

These balls should not be soldered as there may sometimes be a necessity to exchange them.

Our next work must be to make combs. For this purpose we must bend a piece of brass rod into a U-shape, long enough to reach from a point, say 1 inch beyond the sectors to 1 inch beyond the knob of the jars, see Fig. 4. On the inside of the U, as shown in Fig. 3, holes must be drilled about ¾ inch apart, five will be sufficient; into these holes brass pins must be soldered, of such a length as will leave 1½ inch clear between the points.

Supposing the legs of the U are 2½ inches apart, they would be about ½ inch long, and ½ inch from each plate. In Fig 3, at F, a short length of brass tubing is shown screwed and soldered into the knob, file a hollow in the projecting end to receive the comb, adjust the length of the connecting piece to take tbe comb, as shown in the figure, and solder firmly. The ends of the comb must be furnished with small balls or capped with india rubber. Balls will give a better finish, but the caps are equally effective. Having made all the part so far, place the tubes in the caps of the jars, put on the balls with the combs, and steady them by passing the discharging rods through the balls into the tubes. Adjust the tubes until the comb shall stand even and true just across the diameter of the plates. Solder a brass ring around the tube to rest on the cap; there will then be no danger of these getting displaced. Make four pieces of chain, of copper wire, long enough when fastened to the end of the tube to touch the bottom of the jars, by this means the interior of the jars become connected with each other. This will complete the mechanical part of the machine. When we have got so far, all the woodwork must be glass-papered off, and then polished. The brasswork should be worked smooth with emery, and polished with rottenstone, and then properly lacquered, this will give us a handsome machine. A driving belt can be made of the ordinary sewing-machine belt; a good way to join the belt is to cut it 1 inch longer than it will require to be made, put the ends side by side, and then, with strong thread or wire, bind them together for ½ inch, when done the end will stand perpendicular to the belt. It will not look quite so nice as if the ends were scarfed together in the length of the belt, but in passing around the wheels this kind of joint gives no jerk which an ordinary scarf would be sure to do.

We must now look over our work and see that everything is in order. If the discs are too close place a ring of cardboard well varnished between them; if too far apart then, with a rasp take away a little of the projecting part of the boss.

Now an important question is, where can the various parts be procured? To one living in London or other large place, of course there will be no difficulties. I will, however, give the addresses of several houses where I know they may be procured.

Indeed, I may say that I have personally communicated with the firms, and have their authority to say they will willingly supply such quantities as amateurs may require. The prices given do not include carriage.

Messrs. J. Powell and Son, Whitefriars Glass Works, *Temple Street, E.C.*, will supply glass jars 10 inches by 2 inches in diameter, 8d. each. Messrs. J. Frost and Son, Victoria Brassfoundry, 7 *and* 8, *Allen Street, Clerkenwell, E.C.*, brass balls, 1½ inch diameter, 3½d. each; 1¼ inch diameter, 2d. each; 1 inch diameter, 1½d. each. Messrs. Smith and Son, the Clerkenwell Metal Warehouse, 33 to 29, *St. John's Square, Clerkenwell, E.C.*, bright drawn steel

rods, $\frac{3}{8}$ inch, 10d. per foot; treble tube to slide on $\frac{3}{8}$ inch, $2\frac{1}{2}$d. per foot; steel rod, $\frac{1}{2}$ inch, 1s. 4d. per foot; tube for ditto, $\frac{1}{2}$ inch, 3d. Various size brass wire or rod at the same place.

Now a word as to quantities: Mahogany, $3\frac{1}{2}$ feet by 14 inch by 1 inch; steel rod for spindle for discs, 1 foot; ditto for driving wheel, 1 foot 3 inches; brass tubing, 2 feet; brass wire for discharges and neutralizing rods, four lengths of 2 feet each; brass balls, seven large ones as follows: two for disc spindle, one each Leyden jars, and one for discharger. Five small ones 1 inch or less as follows: one for each end of comb, and one for discharger. Leaving out the glass discs and tinfoil one can see approximately what such a machine will cost before he begins his work.

One small matter of detail I have overlooked. Fill the end of the tube carrying the ball, in connection with the two front Leyden jars, with sound cork, and make a central hole to receive the ends of the discharging rods, which, when passed through the balls and into cork, will be firm, and yet may be easily moved to right or left. If these directions in all their details are carefully worked out the amateur will possess a very excellent machine, and one capable of giving at least a six-inch spark.

CIRCULAR SAW BENCH,

WITH PLANING, GROOVING, REBATING, AND MORTISE-BORING ATTACHMENTS.

By OLLA PODRIDA.

II.—TABLE—DETAILS AND CONSTRUCTION OF BORING REST.

THE top of table may now be prepared. In the making of this part the employment of sound well-seasoned timber is imperative, so that as far as possible warping or casting of the surface may be guarded against. The best material would be teak, this being a timber which possesses good "standing" properties. In the majority of cases, however, teak will probably be difficult to obtain. Dry pitchpine would answer very well as a substitute, and, failing that, good yellow or red pine might be employed.

To make the table, a board about 9 feet 6 inches long, by 13 inches wide, and $1\frac{3}{8}$ inch thick in the rough will be required. Reference to Fig. 4 in the Folding Sheet will convey a good idea of the dimensions of the table. As shown, it is 3 feet wide from front to back, and a little over 3 feet in length from right to left, but it may be made 3 feet square. The timber should first be cut into lengths, each a trifle over 3 feet long, to allow for squaring up the ends. The joints should be grooved and tongued. First "shoot" the edges, marking the relation of the lengths, and making sure that when jointed the whole surface shall be fairly level. The "tongues" should be a shade under $\frac{3}{8}$ inch thick and $1\frac{1}{4}$ inch wide, the grooves in the edges of each length being full $\frac{5}{8}$ inch deep and $\frac{3}{8}$ inch wide. The "tongues" must be fitted freely into the grooves, and the whole carefully glued together. It will be found better to glue but one joint at a time, allowing a night to elapse before gluing the remaining one. See that the glue is made thoroughly hot before using, and not too thick. Fasten one length into the bench vice, with the groove uppermost. Take the "tongue" belonging to that joint and swiftly brush the glue over one edge of it. Now slip it into the groove and slide it to and fro once or twice, keeping a steady pressure upon it. Next brush glue over the tongue on each side, and on the edges of the length, and a little on the edges of the corresponding one. These operations should be simultaneous, an assistant holding the second length edge up alongside the one in the vice, so that the brush may cover both at the same time. Not a moment must be lost after brushing the glue over the joint. The second length must instantly be dropped on the tongue and worked to and fro under a steady pressure applied by the "boss" at one end, and the assistant at the other. Of course, care must be taken that the marks on each length are followed so that their relation remains unaltered.

It is immaterial in which direction the grain of the timber runs. In the drawing it is shown, by the stiffening ledge L, to run parallel with the axis of the saw spindle. Arranged thus, it is on the whole slightly weaker than if the grain ran from front to back, but the face will wear better, and there will be much less trouble in fitting the movable piece in the aperture for the saw and cutter blocks, as in the arrangement shown; the movable piece Z rests on the tongues at the front and back, and on the ledge L at the left hand; no support is required on the right.

After the joints have been properly dried, the faces of the table must be planed up level, and the edges truly squared. This being done, the apertures for saw and pulleys must be marked. That for the saw must be cut first, and before cutting the one for the pulleys, the ledge must be prepared and firmly screwed on to the under side of the table. The aperture for pulley need be cut no larger than will just clear the driving belt. The clearance for the spindle and bearings had better be deferred until the latter are in place. The hinges should now be fitted, as also the securing bolts. The presence of the hinges will not interfere with the fixing of the bearings or cut-

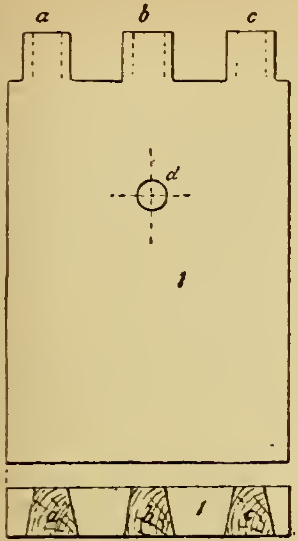


FIG. 23.—BACK PART, OR BASE OF BRACKET FOR BORING REST.
One in Number.

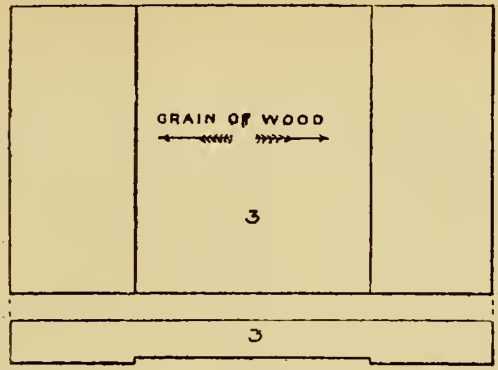


FIG. 25.—BASE OF BORING REST.
One in Number.

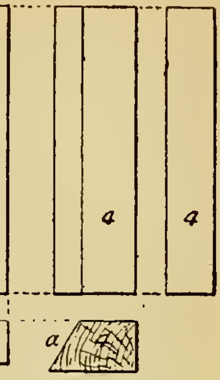


FIG. 26.—V PIECE FOR BASE OF REST. Two in Number.

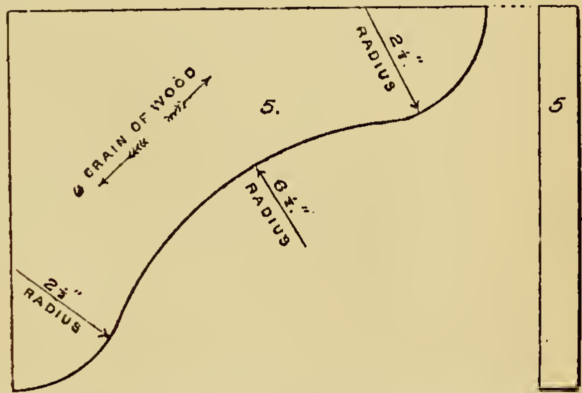


FIG. 27.—SIDES OF BRACKET FOR BORING REST.
Two in Number.

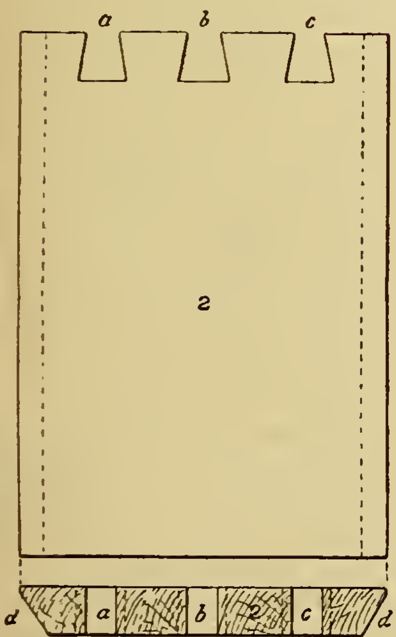


FIG. 24.—UPPER PART, OR SLIDE, OF BRACKET FOR BORING REST. One in Number.

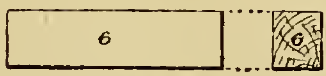


FIG. 28.—SHOULDERS FOR BORING REST. Two in Number.

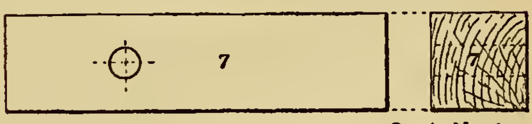


FIG. 29.—TONGUE PIECE FOR BRACKET. One in Number.

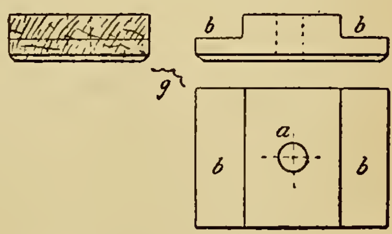


FIG. 30.—PLATE FOR THE SECURING BOLT OF BRACKET. One in Number.

DETAILS OF BORING REST AND BRACKET FOR DITTO.

NOTE.—All Figures are drawn to a Scale of three inches to a foot, or one-fourth full size.

ting of the clearance for the same, as they—the hinges—will allow the table to be turned over out of the way for the former, or into a convenient position for the latter operation.

The table may now be considered finished; but before proceeding with details of the next piece of work a word as to the fixing of the hinges may not be out of place. In marking the position of these, the front edge of the table must be kept exactly parallel to the centre of saw spindle, or—this not having yet been fixed—to the centre line marked across the top of the cross-pieces; this must be attended to, seeing that the front edge of the table top forms the guide in setting the fence parallel to the saw.

Boring Rest and Bracket for Rest.—These must be made of hard wood. Mahogany, oak, or beech may be employed, and should be well-seasoned. The bracket should be taken in hand first. Fig. 23 is the base or back part, and will readily be recognized in the general drawings on Folding Sheet by its distinguishing number—1. To make this part, a piece of timber 9 inches long by 6 inches wide, and 1 inch thick, when planed up, will be required. The dovetail pins at *a*, *b*, and *c*, must be left until Fig. 24 is prepared. To make 24—No. 2—a piece will be required 11 inches long by $7\frac{3}{4}$ inches wide, and 1 inch thick when finished. The bevelled edges shown at *d*, *d*, in the end view beneath, must be planed up before cutting the dovetail, and great care must be taken to make these edges parallel to each other. The dovetailed end must also be squared very nicely to agree with these edges. The openings at *a*, *b*, and *c* must be marked nicely, and cut out very carefully. The pins, *a*, *b*, and *c*, in Fig. 23—No. 1—must be carefully marked from the openings themselves. In cutting out the dovetail members in both parts a fine tenon saw should be used, and if handled with skill little will be left for chiselling except the squaring down of the end grain. The dovetail must be made a good and moderately tight fit, and finally glued, but the gluing must be left until after the sides—Fig. 27—have been prepared and fitted.

These sides—No. 5—will each require a piece of stuff 13 inches long by $7\frac{1}{4}$ inches wide, and $\frac{3}{4}$ inch thick when finished to outside dimensions. As will be observed, the direction of the grain of the wood is noted in the sketch. This is necessary in order that the maximum strength may be offered by the sides. The upper and left-hand edges must be planed truly square with each other. The curved edge is merely a matter of taste, but the radii of the curves are given for assistance in settling the appearance. The sides are secured in place by screws through the base—Fig. 23—and upper part or slide, Fig. 24. The heads of the screws must be let in or countersunk below the surface in each case. The screws should be 2 inches long, and four in each edge will be sufficient.

Fig. 29—No. 7—is the tongue piece or guide for the bracket, and fits between the supports at O, O, Fig. 1, Folding Sheet. It is 2 inches square, and 8 inches long; it should be a snug fit between the supports, and must be screwed firmly to the base of the bracket by three screws, one above and two below the hole for the securing bolt. This hole, shown at *a*, in Fig. 29, and *d*, in Fig. 23, must be bored after the tongue has been fixed to the base.

Fig. 30, lettered E, plate for securing bolt, must also be made of hard wood, recessed or shouldered at *b*, *b*, to fit freely between the supports O. The grain should run at right angles to these supports, or from *b* to *b* in the sketch. The hole at *a*, as also that in the bracket, should be about $\frac{9}{16}$ inch in diameter, to clear a $\frac{1}{2}$ inch bolt. Thin iron washers must be interposed between the wood and head and nut.

The bracket having been completed, we may now proceed with the boring rest proper. Fig. 25—No. 3—gives in detail the base of this part, which must be taken in hand first. To make this part, a piece of timber $10\frac{1}{4}$ inches long by 6 inches wide, and $\frac{7}{8}$ inch thick, when planed up, will be required. Hard wood must be employed. Mahogany would be best, although oak will answer very well. The grain of the wood must be arranged as shown by the arrows on the sketch, and all edges squared up nicely. It will be observed that the middle part is slightly sunk—$\frac{1}{8}$ inch—for a width of 5 inches. This is done that the base may take a better bearing on the slide or upper part of bracket. Every care must be taken in planing up this part, to ensure that no twist is left in it; this precaution applies also to the upper face of the slide—No. 2—on which the rest works.

The next thing to be done is the preparation of the V pieces. These are given in Fig. 26—No. 4—and should be made in one length for convenience. A piece of wood, $12\frac{1}{2}$ inches long by $1\frac{3}{4}$ inch wide and 1 inch thick, when finished to outside dimensions, will suffice for the pair. The bevelled side at *a* must be carefully planed to correspond with the slide, so that when fitted together, a good bearing may result. Each V piece is to be secured to the underside of the base by means of $1\frac{1}{2}$ inch or $1\frac{3}{4}$ inch wood screws, and these screws should be of brass, and also well greased before insertion, to allow of easy manipulation in case of slackness arising through wear and tear in the future. If at any time the rest should become slack through wear of the V's, it may readily be tightened by taking loose one of them, and reducing it in thickness by a shaving or so, replacing it with the same screws in their original positions; to this

end each screw should be marked before removal. In fixing the V's, care must be taken that they and the base are kept parallel and square to the slide. Fig. 28—No. 6—shows the shoulders for the rest. They are each $4\frac{1}{2}$ inches long by $1\frac{1}{4}$ inch wide, and 1 inch thick finished. When fixed in the position shown in Figs. 2 and 4, there will be a space between the inner ends. This affords clearance to the drill or bit in boring. It will be found convenient to use deeper shoulders at times, as the nature or shape of the work in hand may demand. The shoulders should be secured with stout screws, brass preferably, well greased, and properly fitted into bored holes.

The rest must be a snug fit on the slide, not too tight, yet just tight enough so as to be comparatively free from shake, and readily moved by hand in pushing the work up to the drill. Simple contrivances for facilitating mortising and other classes of work within the scope of the machine, will be touched upon before the conclusion of this article, but at present it must be understood that we are only "rigging up," and have not yet therefore commenced to work.

In the next chapter will be described in full detail the construction of the flywheel, and cone pulley for saw spindle. The metal work in connection with the driving gear will also come under notice.

(To be continued.)

MODEL ENGINE-MAKING.

By J. POCOCK.

III.—Working Drawings of Engine—Preparation of Fittings—Bearing Surface of Cylinder—Steam Block — Boring Steam Ways — Crank Casting and Pin—Placing Steam Block in Position—Packing Piston—Completion of Engine.

BEFORE proceeding further, it will be found best to make a full-sized working drawing of the engine, as shown in Fig. 25, where A B is the perpendicular centre line, C, one of the standards, D, cylinder, E, flywheel, F, the crank, G, flywheel shaft, H, crank pin, I, steam block, K, piston, and L, piston-rod.

This drawing is made from an engine constructed from the castings supplied by Mr. Lee, and it will be seen that the cylinder might with advantage have been cut shorter, the cylinder, as sent out, being adapted for a $1\frac{1}{2}$ inch stroke, while the crank only allows a 1 inch stroke.

Fig. 26 shows the same engine as seen from above, C C are the standards, E, flywheel, S, steam block, and T, top of cylinder.

Now having our working drawing ready, we will proceed with the fitting.

The bearing surface of the cylinder, if not turned up in a lathe, must now be finished off as level as possible. For this it should be filed up with a fine file, and then rubbed with water on a good flat stone. It is useful to have a quick-cutting stone, and to keep it for this sort of work. One face of the steam block must also be finished in the same way. The holes by which the latter is to be bolted down to the bed-plate may also be bored at this stage of the proceedings.

A line should now be marked down the centre of each piece, as seen at A B, Figs. 27 and 28. Upon this line punch two centre marks on the cylinder face, in about the positions marked D and E in Fig. 28; also centre-punch the crank for the crank pin and flywheel shaft.

Now draw the diagram, as shown in Fig. 29, as follows:—At right angles to the straight line A B, draw C D, equal in length to the distance between centre marks on crank, and draw D E equal to distance between crank pin H, Fig. 25, and centre mark D, Fig. 28, when engine is in the middle of its stroke. (This may be easily found by adding to Fig. 25 dotted lines showing positions of cylinder, piston, and crank at half stroke, and of centre mark D.) Continue D E to F, making E F equal to distance between centre marks D E, Fig. 28.

Now taking the steam block, Fig. 27, centre-punch on the flattened side the mark F to correspond with the mark D on cylinder face, and with the radius F K equal to D E, Fig. 28, describe the arc H K; turning to the diagram, Fig. 29, take the distance F H with compass, and mark off this distance on Fig. 27 on each side of the centre line A B. The centre marks for the steam ways must be made upon the arc H K, and just within the distance marked off from the centre line, so that the steam ways themselves, when drilled, may be just within the mark, as seen at H and K, Fig. 27. Figs. 30 and 31 will show the manner in which the steam ways are bored, Fig. 31 being a section of the steam block on the line A B of Fig. 30, and H and K the steam ways.

Bore the holes D and E in cylinder face, as marked in Fig. 28, and tap a screw in D. Take a piece of brass wire 1 inch long, and screw about $\frac{1}{4}$ inch at one end to fit D, and $\frac{1}{2}$ inch at the other end. Take a piece of brass, rather under half an inch in diameter, and after boring it to take the same thread as that with which the hole D has been screwed, turn it down, partly cut off about one-eighth of an inch, mill the edge, finish cutting it off with a parting tool, and screw a hole in the centre with the same tap as that used for D. Now take a piece of wire a trifle larger than the piece just used, and round it twist a piece of

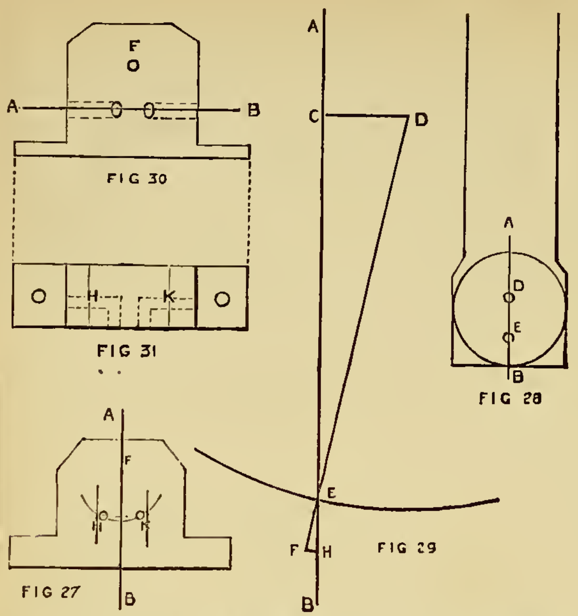


FIG. 27.—DIAGRAM OF STEAM BLOCK. FIG. 28.—CYLINDER FACE. FIG. 29.—DIAGRAM SHOWING MODE OF DETERMINING DISTANCE BETWEEN CENTRE MARKS D, E IN FIG. 28. FIGS. 30, 31.—DIAGRAM SHOWING HOW STEAM WAYS ARE BORED, IN SECTION (FIG. 30) AND PLAN (FIG. 31).

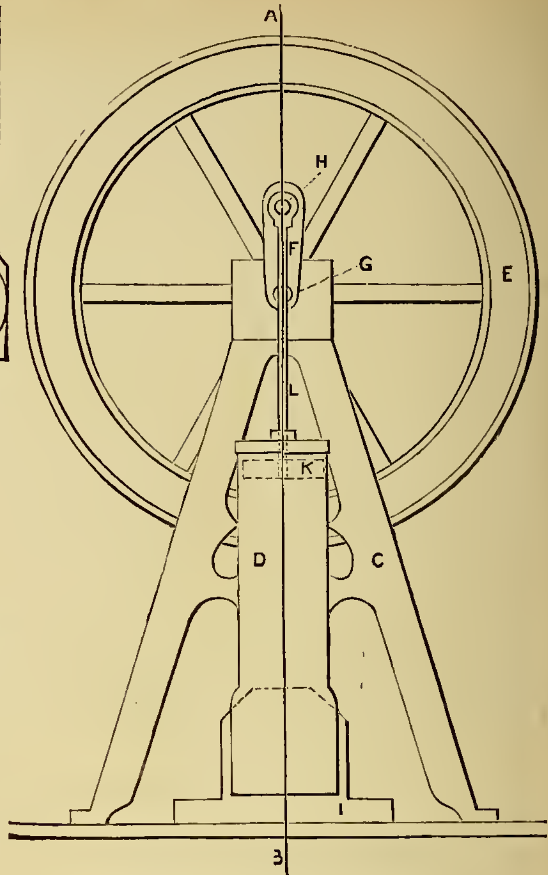


FIG. 25.—WORKING DRAWING OF ELEVATION OF ENGINE.

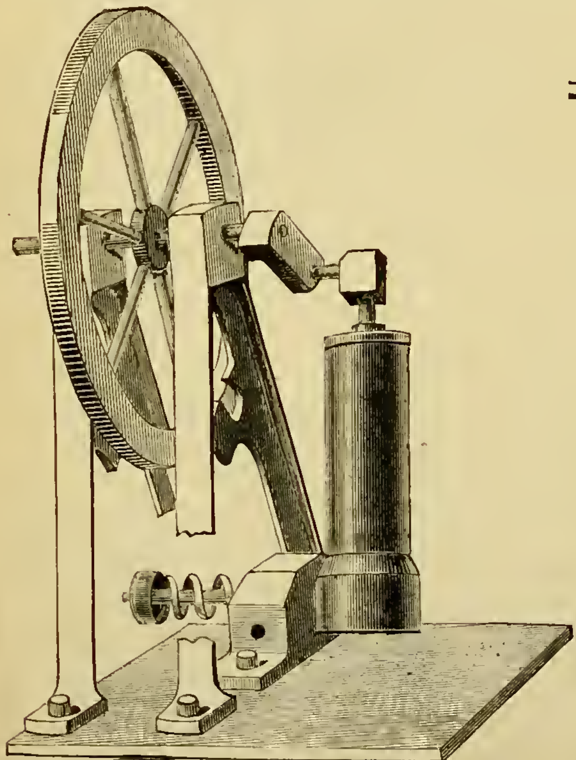


FIG. 32.—PERSPECTIVE VIEW OF ENGINE, COMPLETE.

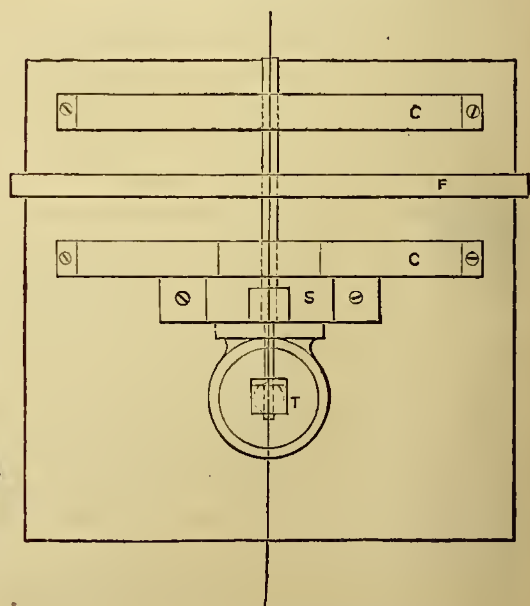


FIG. 26.—PLAN OF ENGINE AS SEEN FROM ABOVE.

cold drawn brass wire to form a spiral spring half an inch in length.

Bore the hole in the steam block F, Fig. 30, a trifle larger than D, Fig. 28, so that the piece of screwed wire will pass through it easily, yet without having much room for play.

Tap the ends of the steam ways at the sides of the steam block for steam and exhaust pipes respectively.

Now give the cylinder face and surface of steam block a final rub with a little oil upon a good flat oil-stone to take off the burrs at the edges of the drilled holes, etc. Probably no great difficulty will be experienced in getting the surfaces true and flat. To ascertain whether you have succeeded in obtaining a good fit, you have but to smear one of these surfaces with a little red lead and then press the other against it.

Screw the piece of wire into its place in the bearing face of the cylinder, push it through the hole bored for it through the steam block, pass the spiral spring over the end of the wire projecting on the other side of the steam block and screw on the small milled nut. It will be seen that by means of this nut the tension of the spiral spring can be altered, and the surfaces of the cylinder face and steam block brought together with more or less pressure as required.

The crank casting may now be bored and tapped, and the shaft cut off to project $\frac{3}{8}$ of an inch beyond its bearings, and one end screwed to take the crank. The crank pin is formed of a small piece of steel wire, $\frac{1}{2}$ or $\frac{5}{8}$ of an inch long, one end being screwed to fit the casting.

Now bore a piece of brass measuring about $\frac{3}{8} \times \frac{1}{4}$ of an inch with a hole a trifle larger than crank pin. File up this piece of brass square, or, if preferred, it may be turned off a piece of rod in the same manner as the tension nut was formed. Drill a hole in the edge, and tap this to take the top of the piston-rod, which must also be screwed to fit, after it has been cut off to the right length. This may be ascertained by a reference to the working drawing.

Now the steam block may be placed in position upon the bed plate, with the crank upon the shaft, and the head of the piston-rod upon the crank pin; and taking care that the centre upon which the piston works is directly under and parallel with the shaft of the flywheel, mark the position for the holes in the bed plate which are to receive the screws by which the steam block is to be held in place. It will probably be found that the steam block comes partly between the legs of the front standard.

The holes in the bed plate are now to be drilled, and the steam block bolted down to it. It may probably be found necessary to make the heads of the bolts which secure the steam block very shallow, so that they may not interfere with the screwing in of the steam and exhaust pipes.

The piston must be packed with a little tow and oiled; and now, with a little oil upon the shaft of the flywheel and on the cylinder bearings, our engine stands complete and in working order, as shown in Fig. 32, where it will be observed, however, that part of both standards has been omitted in order to exhibit the tension spring with greater clearness.

THE REFLECTING TELESCOPE:

ITS CONSTRUCTION AND MANUFACTURE.

By EDWARD A. FRANCIS.

VIII.—THE POLISHING OF THE SPECULUM (*continued*).

A CONTEMPORARY of James Short, Mr. John Mudge, leaves it on record that he polished his specula always in spring or autumn. The summer he found too hot to permit the pitch to maintain a desirable condition; the winter, for the same purpose, was too cold. A slight consideration will show that the workroom warmed to summer heat would render winter no obstacle, while the use of a harder kind of pitch would enable one to work in summer. On one occasion the writer completed a mirror on Christmas Eve, and the pitch, although in a room without a fire, was perfectly pliable, but then the eve of Christmas in England has often more of the traits of the opening than of the final season of the year.

At the end of the last chapter the speculum was left resting upon the newly-formed polisher. It is possible for several things to be wrong with the polisher; if any of them be, or not, will be very evident at the first attempt to polish. Accuracy in every detail will result in the speculum moving with an easy regular motion over the polisher, very soon after the workman begins to polish; inaccuracy will cause adherence, not absolute, but intermittent and tantalizing. If the channels between the facets be too narrow (*i.e.*, if they have been cut smaller than was directed), if the pitch be too soft, or too hard, or not homogeneous, or badly moulded, the speculum will refuse to work properly. This should result in the would-be optician taking a cool survey of his position, and deliberately deciding to which of the above causes the error is due. If the channels be too narrow, widen them to the directed size. If the pitch be too soft, as will be evident from the tarry appearance on the glass surface, and a general tendency of the facets to expand, scrape it off, and construct a new polisher; there is no other cure. Is the pitch too hard? (it

should yield to a gentle pressure of the thumb nail), resort to the same arbitrary remedy. Bad moulding can be amended by warming a part or the whole of the polisher and remodelling it.

All being well, the polishing may be proceeded with for about the space of half an hour, confining the movements, however, to one-third straight stroke and a very slight side motion. The elbows should be kept well to the sides, and the whole body swung gently to cause the stroke, maintaining always constant rotation of the speculum under the hands, and walking round the bench slowly. Very slight downward pressure will be required, the hands merely guiding the glass in its path.

It is now necessary to indulge, for a time, in one of those theoretical dissertations which the reader was spared in the opening chapter, and which will require for its easy understanding a reference to the illustrations of the first paper.

After thirty minutes' work the polish will have begun to appear on the glass with a rapidity which will, most probably, surprise the workman. From that time until the finish it will be necessary that he should continue, not with a helpless dependence on chance, but with a knowledge at any moment of the precise figure of the glass under his hand.

It was demonstrated, see pages 7 *et seq.*, that the curve required for the great speculum of a Newtonian telescope is a parabolic curve. To change a spherical to a parabolic curve it must either be deepened at the centre or flattened at the edge. Let this be illustrated by an anecdote. When Lord Rosse, in the year 1828, was experimenting at Parsonstown, he knew nothing of the direct method of figuring. What he did know, was that which has just been stated, the difference between a sphere which he could obtain, and a parabola, which, of course, was what he required. Knowing this he constructed a 6-inch metallic mirror, of 2 feet focal length, in two parts, the central part about three inches in diameter, separate from the outer part, and to the complete metal he communicated a spherical figure. A reference to Fig. 3, page 8, will show how the central part of a spherical speculum reflects the rays to a greater distance from the mirror, than does the outer part. So Lord Rosse made the inner portion adjustable by a very fine screw motion, and then very delicately withdrew it with respect to the outer ring until the images reflected by both portions coincided, when necessarily the spherical aberration * was greatly reduced; but the experiments were abandoned. Very evidently then deepening the centre is one way of correcting the sphere, a careful study of Fig. 3 will show that the same result could be obtained by flattening the edge, and so lessening slightly there the angles of incidence and reflection. The manner of procuring either of those alterations of figure shall be hereafter explained; it is necessary first to enquire into the method by which we are to tell whether the glass speculum is of a parabolic figure or not, and, if not, what parts of the surface should be specially acted on to obtain the desired curve.

The methods of testing the figure of any speculum were, previous to the year 1858, very primitive, being chiefly confined to the examination of a watch dial, or some similar object, placed at a considerable distance from the telescope, or of a star. The tests were most generally based upon the fact that an accurately polished parabolic concavity will reflect an image of a star to a focal point equi-distant from all parts of the reflecting surface. A reference to Fig. 43—a sketch of Mr. Mudge's testing apparatus—will show the manner in which this peculiarity was pressed into the service of the optician. The outer circle, A, B, C, is intended to represent an end view of the telescope tube. Into the tube was fixed a wooden cross-bar D, carrying a flat ring E, formed of pasteboard. The ring E, cut off the light from a part of the speculum between the centre and the edge, which part was assumed to be perfect. A small disc F, and a larger flat ring G, were also prepared to cut off the light when required from the central and extreme portions of the speculum respectively.

If the telescope, being completed, but having the ring E, and the disc F, fixed to shut off all the light from the central parts of the speculum, were turned on a distant object, an image of that object would be formed by the outer portion of the speculum only, and might be carefully focussed with the eye-piece. It has been stated that the reflected image is in a perfect speculum equi-distant from every part of the reflecting surface, and therefore, if the ring G and the disc F were swung round upon the pivot H, so as to cover the outer part of the speculum and leave the central part exposed, the reflected image formed by the newly exposed surface, should occupy precisely the same place as did the previous image. If it did not, an adjustment of the eye-piece would be necessary for distinct vision, and it was the profession of the optician to determine partly, from this adjustment, the amount of deviation of the curve of the speculum from the true figure, and the manner of remedying it. The reader should understand that placing the screens at the mouth of the telescope tube would be equivalent to placing them immediately in front of the speculum.

Mr. John Hadley, about the year 1720, made a step in advance in the method of determining the configuration of any concave surface. It will be re-

* See Chapter I.

membered that that end of the radius of curvature * most distant from the speculum is called the centre of curvature. Rays of light emanating from the centre of curvature of a concave mirror will be reflected exactly back again to that point. Mr. Hadley placed a candle having a punctured screen before it at the centre of curvature, and then examined the reflected image of the aperture with an eyeglass, as in Fig. 40, and by the distinctness with which its rugged edges were pictured, and by the appearance of the converging and diverging rays on either side of the focal point, the quality of the reflecting surface was discovered, and to one experienced in mirror working, the procedure necessary to improve that surface was indicated.

Until the year 1857 those two methods separately and combined, or occasionally entirely modified, were used, but in February of that year, M. Leon Foucault communicated to the Academy of Sciences in France a new method of examining the surfaces of specula, in part similar to that of Mr. Hadley but capable of far more certain and delicate application.

The Foucault system, really embraced three separate tests. With the first of these it is not proposed to deal, it was merely the substitution of a thin lath having parallel sides (as a flat wooden measure) for the candle flame. By viewing the reflected image of such a lath it is possible to judge of the general accuracy of the curve of the reflecting surface.

The second method is beautiful in its simplicity, and it can be described far more easily than it could be adapted: since it would require for its application a testing room of very considerable dimensions. A parabolic speculum will reflect rays received from an object infinitely distant, so as to form a perfect image at the principal focus, which is half way between the speculum and its centre of curvature. Conversely, light rays from an object placed at the principal focus would be reflected so as to form a perfect image at an infinite distance. Remembering this, M. Foucault first placed a luminous point at the centre of curvature (as did Mr. Hadley) and polished the speculum until the reflection was perfect. Then he moved the source of light nearer towards the mirror (and consequently towards the principal focus) and polished until the reflected image was again perfect.

Then the light was approached to the speculum still more, and, of course, the reflected image rapidly retreated and became indistinct, only to be perfected again by further polishing. It is evident that the application of this method would only be limited by the length of the apartment, and that a little experience would indicate to the workman what correction further than that which could be tested for, would be necessary to perfect the parabolic figure. This test in a modified form, may be occasionally called in to our aid.

The third system, it is, however, upon which the method about to be described is based; by it the speculum may be completely finished without leaving workshop and testing room.

The reader may glance at the sketch herewith, Fig. 39. In it the artist has depicted a testing room † in all its simplicity. No elaborate instruments can there be seen, no other appliances being required than the mirror, a lamp, a metal shade for lamp, and a thin metal screen.

The mirror will require no special preparation. When it is removed from the polishing it should be allowed to dry and then be lightly polished with a soft chamois leather, to remove the rouge. The box shown in the sketch, for supporting the mirror while it is being tested, should be of stout seasoned wood.

The lamp with its shade is illustrated in Fig. 41. The kind of lamp used is immaterial, indeed, for the word lamp, light may be conveniently substituted, for from a rushlight to the oxyhydrogen or electric light, anything will do. The shade is cylindrical and is formed of thin sheet metal, tin, or brass. It should be of a size sufficient to permit it to be slipped on over the candle or lamp glass, so as to imprison all the light save that which escapes through two holes punctured in it, in a position which would be exactly opposite the brightest part of the lamp flame. Of the holes, the one should be about $\frac{1}{20}$ part of an inch in diameter the other about $\frac{1}{300}$ ‡ of an inch. The former may be drilled or punched out; to form the latter, procure the very finest sewing needle, and file away the surface of the metal cylinder in the selected spot, with a fine cut file until the metal is very much reduced—as thin as the paper upon which this is printed. Then slip the cylinder over a metal rod (the lathe mandrel for example) and with the needle punch a tiny hole, the needle point just piercing the metal. The shade should be so arranged, when on the lamp (or candle) as to permit free ventilation. The rays of light then rushing out of the tiny holes are to be used for artificial stars; and the brighter and smaller they can be formed the more delicate and more accurate will the testing be.

The arrangement of the metal screen will be better understood when its use is defined hereafter; indeed, if the reader will but study to master the use of the simple apparatus used in testing, he will see that no special method of construction need be followed.

* The radius of curvature is twice the focal length, in our case, 5 by 2, or 10 feet. *See previous papers.*

† See the opening sentences of Chapter III.

‡ M. Foucault required the smaller aperture to be $\frac{1}{12}$ millemetre, or about $\frac{1}{305}$ of an inch in diameter.

The screen is illustrated in Fig. 42, and could be formed easily from a block of wood or metal, and an old table knife. It is only absolutely necessary that the knife should be fixed vertically in the block, and should have its edges straight and parallel.

For the rest of the description it will be assumed that the reader is in a room preparing to test, and that the writer with him is occupying his customary occupation of mentor.

The diagram, Fig. 40, is a plan of the testing apparatus figured in the sketch, Fig. 1. The mirror is indicated at A B, the lamp at C, and the screen near to the observer's eye at D.

Place the lamp C at ten feet (or whatever distance is proper if the reflector has been made of more

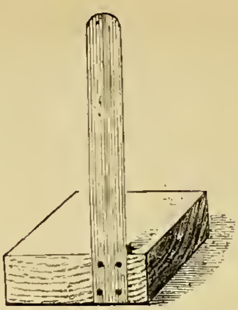


FIG. 42.—METAL SCREEN FOR TESTING.

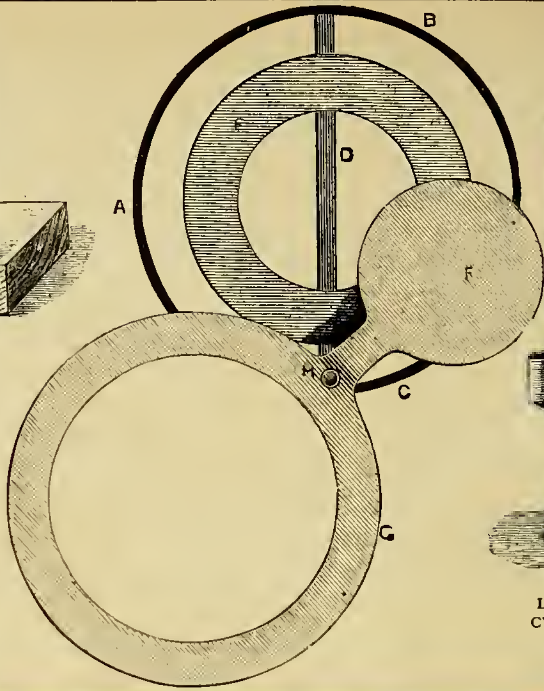


FIG. 43.—MR. MUDGE'S TESTING APPARATUS.

FIG. 41.—LAMP WITH CYLINDRICAL SHADE.

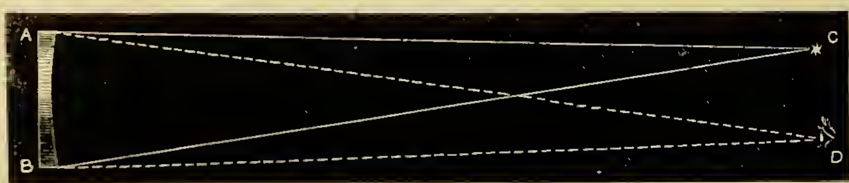


FIG. 40.—DIAGRAM SHOWING SECTIONAL VIEW OF ARRANGEMENT IN FIG. 39.
[A B, Mirror; C, Lamp; D, Reflected Image and Observer's Eye.]

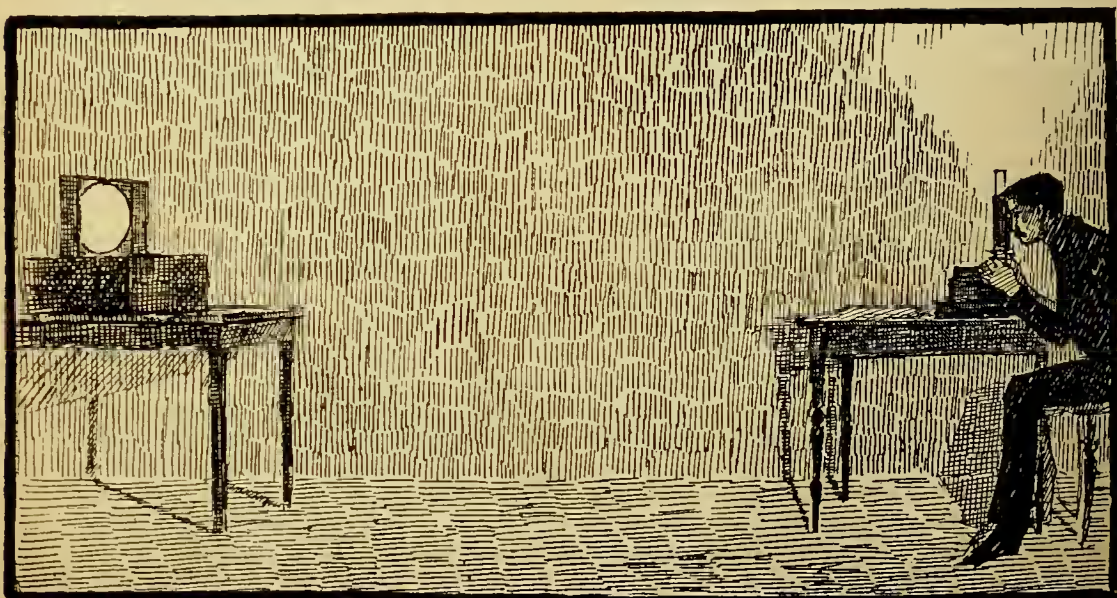


FIG. 39.—SKETCH SHOWING GENERAL ARRANGEMENT OF SPECULUM AND APPARATUS WHEN TESTING.

or less than five feet focal length) from the speculum, which has been placed in its box on edge on a firm table, the centre of the speculum and the artificial larger star of the lamp being in one straight line. The rays proceeding from the lamp C will impinge on A B, and be reflected back exactly to C again. But if C be moved slightly towards the right (as in the figure) the reflected image D

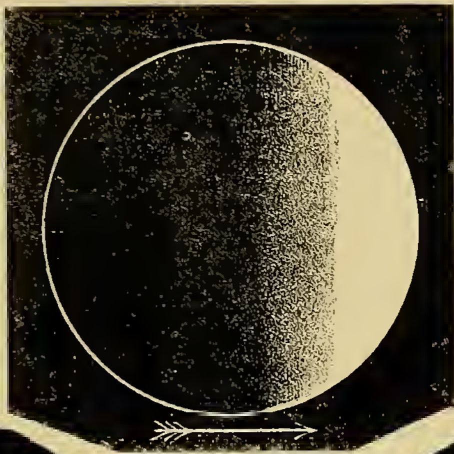


FIG. 44.—APPEARANCE OF MIRROR SURFACE WITH TESTING SCREEN BETWEEN CENTRE OF CURVATURE AND MIRROR. Arrow indicates direction in which screen is advanced from left to right in this and other size.

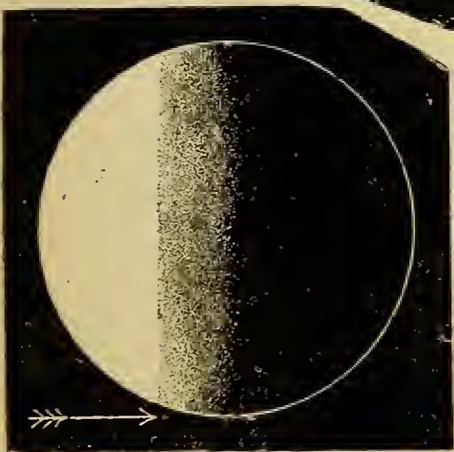


FIG. 46.—APPEARANCE OF MIRROR SURFACE WITH TESTING SCREEN BETWEEN CENTRE OF CURVATURE AND EYE. Arrow shows direction of advance of screen from left to right.

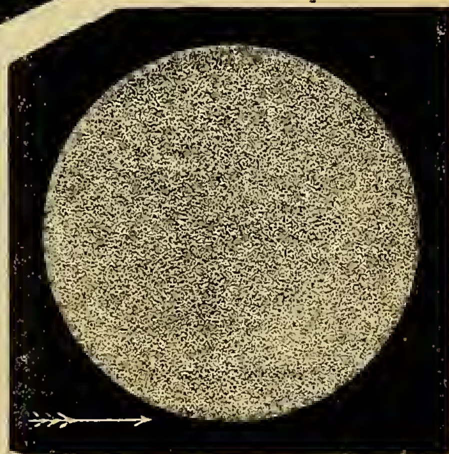


FIG. 48.—SPHERICAL APPEARANCE OF MIRROR SURFACE WITH TESTING SCREEN AT CENTRE OF CURVATURE. Arrow shows direction of advance of screen from left to right.

FIG. 47.—SHOWING ACTION OF TESTING SCREEN ON RAYS REFLECTED FROM SPECULUM IN TESTING TO PRODUCE APPEARANCE INDICATED IN FIG. 8.

will move a similar distance towards the left, and thus the observer will be enabled to view the reflected image without intercepting any portion of the incident light with his head. To determine simply the position which the lamp should occupy on its table, the cylindrical screen may be removed and the lamp be taken in the right hand at the level of the table, the eye being brought down beside the lamp as when testing. On approaching to within a distance of a few feet from the speculum, an erect and slightly magnified image of the lamp will be visible in the concave surface. On retiring from the speculum this image will be seen to enlarge. In order to keep the image in one position with regard to the eye, it may be found necessary to raise or lower the lamp above or below the level of the table; in which case the mirror should be adjusted by means of a thin wedge inserted underneath the front or the back of the box, until the lamp can be

FIG. 45.—SHOWING ACTION OF TESTING SCREEN ON RAYS REFLECTED FROM SPECULUM IN TESTING TO PRODUCE APPEARANCE INDICATED IN FIG. 6.

FIG. 49.—SHOWING ACTION OF TESTING SCREEN ON RAYS REFLECTED FROM SPECULUM IN TESTING TO PRODUCE APPEARANCE INDICATED IN FIG. 10.

carried completely back and placed in position upon its table without the workman losing sight of the reflected flame, which at that distance will flood the speculum with light.

A piece of card may now be held up beside the lamp C, and shaded from all but light reflected from the mirror, when an image of the flame inverted should be plainly pictured upon it. The screen may then be placed upon the lamp having its largest aperture, fully illuminated, turned upon the speculum. That aperture is $\frac{1}{20}$ of an inch in diameter, and a little circle of reflected light of that size should appear on the card in place of the flame.

So far, Mr. Hadley's or Foucault's second method, for here a suitable eye-piece could be applied, and if the mirror were accurately spherical, the aperture would be excellently defined in its minutest details, but we will not pause to discuss the completion of the eye-piece test just yet.

The reader may now darken the room slightly, draw up his chair, take his little metal screen, and receive an elementary lesson in shadow testing.

The distance between the lamp and the reflected spot of light should be just sufficient to prevent the workman's head touching the lamp shade. The lamp, it has been said, should be to the right, therefore, the right eye can be placed so as to receive the whole of the rays which form the little reflected disc of light; and since those are all the light rays reflected from the mirror, the latter will appear to be brilliantly illuminated like the moon at full.

In a case where the workman is in the habit of using his left eye, the position of lamp and screen may be reversed, and the screen moved from right to left, but in such a case Figs. 44 and 46, and others which may follow, would require to be inverted.

The use of the metal screen may now be demonstrated. Fig. 49 illustrates the path of the rays reflected from a spherical surface, the screen is used to shut off from the eye any part of this reflected light. It should be raised to such a height that the reflected spot of light would about bisect it. If the observer place his right eye so as to receive all the reflected rays, and then while watching the illuminated mirror passes the screen slowly with the fingers across the reflected light cone (to the right) the speculum will appear to darken. We will assume for the moment that the concave surface has polished accurately spherical, and that the opaque edge cuts the rays exactly at the centre of curvature, then the speculum will darken evenly all over, because the smallest point of the reflected disc is formed by rays from every part of the reflecting surface. The mirror will then present the appearance indicated in Fig. 48, and explained in Fig. 49. It is far from probable that the surface will have polished to the assumed curve, and there will most likely be visible, just as the light is fading out, much irregular shading; of such shading, the means whereby the errors of curve are discovered, we will at present take no further notice.

Again, the chances are a good many against the screen being placed at the exact centre of curvature immediately. Perchance it will be placed too near to the reflector, in which case the speculum will present the effect shown in Fig. 44 for the reason plainly indicated in Fig. 45. To reach the centre of curvature the screen must then be moved back towards the eye, until the effect illustrated in Fig. 48 is produced.

Or, the screen may in the first instance be placed too near the eye, when an opposite effect, Fig. 46, for the reason shown in Fig. 47, will result, and an opposite action to that mentioned above should be resorted to as a remedy.

As before written, the room for testing must be free from tremors—one of the leading telescope-makers, indeed, removed from London to avoid the tremor prevalent there, which though it would scarcely interfere with the working of our small surface, would seriously impair the chance of success in the manipulation of a great speculum.

The method of supporting the speculum which has been here given is merely that resorted to by the writer; almost any convenient mode of support would answer. The mirror is in some cases supported against a wall by a flexible band.

The reader having learned how to discover, by test, the centre of curvature, should now be in a position to follow me farther, in the next Chapter, into the mysteries of testing, by a path somewhat difficult perhaps, but certain in the fact that it leads to success.

I inadvertently omitted to state at the end of Chapter V. that Fig. 30 was reproduced from Holtzapfel's "Turning and Mechanical Manipulation."

(*To be continued.*)

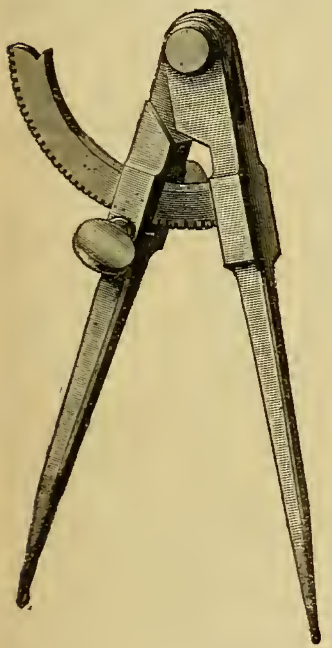
NOTES ON NOVELTIES.

By THE EDITOR.

35. Dale's Price List of Electrical and Physical Apparatus. 36. Melhuish's New Steel Compasses. 37. Messrs. Harger Brothers' "Eclipse" Pocket Compasses. 38. Busschot's Mosaic Stringing for Inlaying.

35. DALE'S PRICE LIST OF ELECTRICAL AND PHYSICAL APPARATUS.—I can strongly recommend to those of my readers who are interested in matters electrical a useful and handy pamphlet, recently issued at 4d., by Messrs. H. and E. J. Dale, Manufacturing Electricians, 26, *Ludgate Hill, London, E.C.* This "Complete Illustrated Descriptive Price List of Elec-

trical and Physical Apparatus" consists of 112 ges, and will be found particularly valuable and helpful by amateur electricians, because it gives the prices, sizes, qualities, etc., of every kind of apparatus that produces or generates electricity, and all appliances that are worked by the agency of the electric fluid; and most of the articles supplied by Messrs. H. and E. J. Dale are illustrated in this price list, which, for obvious reasons, renders it still more desirable. It is divided into three sections, the first of which, containing sixty-four pages, is devoted to Experimental and Electric Ligbt, etc.; the second, of eight pages, to Medical Electric Appliances; and the third to Electric Bells, Speaking Tubes, Lightning Conductors, etc. Almost any question that can be asked with regard to electric apparatus and materials may be answered by the aid of this volume, whicb deserves a place in the particular portion of the bookshelves set apart by the amateur for the reception of handy guides and vade mecums of a similar character, aim, and scope.



MELHUISH'S NEW STEEL COMPASSES.

36. *Melhuish's New Steel Compasses.*—The old form of carpenter's compasses, or indeed compasses for wood and metal workers, having one arm, or leg, working on a thin piece of metal, shaped in the form of a quadrant or fourth part of a circle, is well known. Messrs. Richard Melhuish and Sons, 85 *and* 87, *Fetter Lane*, *Holborn Circus*, *E.C.*, have shown me a new and improved form, which I can recommend to any of my readers who may be in want of such an article. From the annexed illustration their shape, construction, and the improvements to which I have alluded may be clearly seen. In the first place the sbape of the legs is altogether better, the lower parts being finer and less clumsy. The lower edge of the quadrant is notched, and a small cog or screw works in the notches, and by its means the distance between the points may be regulated with the utmost exactness, as all that need be done is to apply the compasses to a rule, and then to turn the screw one way or the other, as may be required until the precise distance has been obtained. The head of the screw has the form of the ordinary thumbscrew. The leg that works on the quadrant is held immovable at any distance within the utmost limits of the opening of the legs by a set screw, which will be noticed in the illustration just above the quadrant, in the opening between the quadrant and the legs. The price of these well-made and useful compasses is 5s. 6d., post free.

37. *Messrs. Harger Brothers' "Eclipse" Pocket Compasses.*—In Vol. III., page 181 of this Magazine, I had the pleasure of noticing a very useful novelty under the name of the "Eclipse" Pocket Compasses, introduced by Messrs. Harger Brothers, *Settle*, *Yorkshire*, who have patented the appliance. They have sent me what I may term a new edition of the compasses revised, improved, and considerably augmented. Messrs. Harger Brothers observe, modestly enough, that the "improvement effected is in the screw, which is made sufficiently strong to hold the arm tight without the necessity of a stay." On comparing the old form with the new form I find that the latter is superior to its predecessor in many important particulars. In the first place, the arm is about $\frac{1}{4}$ inch longer and much more solid; the barrel which takes the pencil is also longer and stouter, and less is taken out of it and turned back, to form flanges in which the arm is set. The screw in the old form was slight, and the fastening was in the form of a tiny hexagonal nut, but in the new form the length of the pin on which the arm works is increased and held in place by an internal screw with a milled head, the pin on the other side being also finished in this manner. The screw can at any time become tightened should the arm become at all loose. Taken altogether, the new compasses are altogether stronger and better for working with than the old ones. The compasses are nickel plated. I note that the old form was supplied at 9d. post free. Messrs. Harger Brothers do not say if the price is increased; but I can testify that the new form is honestly worth more than the old one, and even if offered at 1s., is cheap and well worth having.

38. *Busschot's Mosaic Stringing for Inlaying.*—Mr. G. Busschot, of the "*Fretwork Emporium*," 33, *Park Lane*, *Liverpool*, who frequently gives us the advantage of his advice and experience in "Amateurs in Council," advises me that he has received a large collection of mosaic stringings for inlaying from Paris, with which he is now ready to supply cabinet-makers and amateurs. He also sends a specimen card—Card No. 1—containing twenty-two different samples, in widths ranging from $\frac{1}{8}$ inch to $\frac{3}{4}$ inch, and of various patterns and colours. These stringings range in price from 4d. to 1s. 11d. per yard, according to intricacy of design. The mosaic work in all is done with perfect accuracy, and the effect of each when placed *in situ* and scraped and polished cannot fail to be satisfactory. Those who are fond of inlaying should write to Mr. Busschot for one of his sample cards, which he supplies at 4d. each. He has a large stock in hand, having no less than one thousand varieties in mosaic stringings for inlaying, marquetry, and for centre pieces. He does not supply less than a yard, but if to be sent by post, he will cut it into foot lengths, for convenience and security of transit. Mr. Busschot has some designs "*Il Traforatore*" and "*Il Dilettante*," which he recommends, but with which I am not acquainted, and he supplies every kind of appliance and material for fret-cutting, inlaying, etc., dyed veneers of all colours, and "Demon" Saws for fret-cutting, with teeth on both edges. These saws he sells at 6d. per dozen, or 4s. 6d. per gross.

AMATEURS IN COUNCIL.

**** For Instructions to Correspondents, see page 44 of this Volume.*

Model Printing Press.

*** I have received a letter from the manager of the "Model Printing Press Company," 3, *Ludgate Circus Buildings, E.C.*, stating that the firm of C. G. Squintani and Co., formerly of that address was dissolved, January 1st, 1885, and that all applications for presses, type, etc., should be made *direct to the Company* at the same address as given above.

Dynamo Machine Connections.

HONG KONG.—I am sorry you should have been kept waiting so long for a reply to your questions on this subject, and still more sorry to inform you that your list of questions have been lost. The letter was sent to a contributor who generally answers such questions, and he sent it to a practical man requesting his advice. Before the answer could be written, our contributor was placed *hors de combat* by illness, and the letter was lost. If the following information (given as a reply to your questions as remembered by our contributor) does not meet your case, please repeat your requirements. When the armature of a dynamo machine is wound with wire in sections, as in a Gramme machine, the ends of each section are connected by means of small set screws with two sections of the commutator, one on one side of the boss, and the other wire on the opposite side, using as many sections to the commutator as there are ends of wire. A machine thus fitted is said to be coupled in "multiple arc" or "quantity" connection. When the ends of the various sections are connected one to another in groups, and the number of commutator sections are lessened, the machine is said to be connected in series. When the field magnets of a machine are wound with two wires—fine and coarse—and the fine wire is made to form an independent circuit closed within the machine itself, or, when the circuit is closed in t e machine with a wire or coil of high resistance, then the machine is "shunt wound," or is fitted with a shunt. By such means as these, a small portion of the current is made to pass around the magnets, and they are always magnetized whilst the machine is running.

Dynamo Electric Machines.

H. M. (*Wincanton*).—The principal causes of failure are usually as herein stated: (1) In winding the wire on the armature, or on the field-magnets, the covering is damaged by pulling the wire too tight over a corner. In such a case as this the bared wire is brought into contact with the iron of the armature or field, and the work of winding is labour lost. To detect this fault, connect one end of the wire to a strong battery, connect the other pole of the battery with a galvanometer, pass the current through the galvanometer to the iron of the armature or field-magnets, or try to do so. If you succeed in causing a deflection of the needle, you may be sure that a fault exists in the winding, for, if the wire is properly wound on and insulated, the current will not pass from it to the iron. If a fault is detected by this means, you must unwind the wire carefully, find the fault, recover the damaged part, and wind afresh. (2) The second likely fault is that of giving an imperfect lead to the brushes and commutator. Alter the brushes until you get the proper lead. They do not require to be insulated. (3) Another fault is that of connecting up the wires of the field-magnets wrongly to the terminals. For the right method, see my article on "How to Make a Small Dynamo Machine," in the last volume. (4) Another fault is that of bad connections. Are you quite sure that the wires of the armature are cleanly connected to the commutator? If every part is properly put together, as far as you can determine, test the machine in the following manner. First run it free and unconnected for a few moments. Then bridge the two terminals with a thick wire, and run the machine at a speed of 500 revolutions per minute for a few minutes. If the machine is all right, it will soon begin to run stiff and hard, because the fields will become magnetised and pull at the armature. If it runs free and easy with the terminals connected, then there is something wrong with it, and you must again overhaul it until you find out the fault.—G. E.

Electro Magnetic Machine.

S. P. (*Stoke*).—A fully illustrated description of an electro magnetic machine and how to make it, appeared in AMATEUR WORK, Part 23, Vol. II., page 551. All the necessary parts may be obtained from Mr. Dale, 4, *Little Britain, London*, or any other electrician advertising in this journal. Cost from 15s. to 50s., according to quality and size.—G. E.

Induction Coil.

R. S. (*Birmingham*).—The published results of experiments made with induction coils have been obtained from experts in the art of building coils, and must therefore be taken as the maximum effects likely to be produced. This is not always attained by the novice or amateur in his first effort. I learn from experienced experts that a very slight fault will diminish the expected length of spark. The most common faults are: (1) Slight imperfections in the covering of the wire when these are close to each other. (2) Knots in the wire itself, made before it was covered. (3) Irregular winding. When the metal of the wire is exposed, and two such exposed specks lie close to each other, part of the current passes from one convolution to the next, and, as the length of spark is to a great extent determined by the length of wire through which the current passes, a short cut across the convolutions must diminish the length of the spark. Knots and imperfect connections in the copper wire before it is covered, will also diminish the length of spark by resistance to the current. Irregular winding will also shorten the spark, because it causes cross currents and consequent resistance. A perfectly wound coil has its convolutions side by side, as a reel of cotton is wound. I should recommend you to make experiments with the condenser, altering the number of sheets, with a view to obtaining the best result from your coil, but I do not advise unwinding the wire, because you might break the wire. It would be better to build a new coil with more care if possible. The solution in your cells gets warm because a large volume of current is made to pass through a thin volume of liquid, or there is small resistance in the outer circuit.—G. E.

Electric Light.

J. W. (*Stoke*).—Many thanks for your appreciative letter. I am always pleased to have such letters describing the success or failure of attempts at following the instructions given in AMATEUR WORK. Your success with electric bells is most encouraging. The bell must have been well made to ring with current from one cell only. The Bennett cell failed because the porous pot was not sufficiently sealed to exclude air from the caustic soda solution. If air is allowed to act on a solution of caustic soda it soon converts the solution into one of common soda, which is useless in a Bennett cell. I prefer the Leclanché, or a similar battery—that is, a sal-ammoniac battery. Respecting your queries relating to electric light—(1) I am not practically acquainted with Dale's Special Leclanché Battery for electric lighting with a three candle-power incandescent lamp. (2) The ordinary gas burner gives a light of from 15 to 20-candle power, or over, according to the quality and pressure of gas. Burners vary much in the quantity of gas they pass in an hour, and also in the shape of the flame, both of which affect the candle-power of the light. (3) The ordinary bichromate battery gives a stronger current than a sal-ammoniac battery. The first rush of current is very strong, but it fails in a few minutes unless heated or kept agitated. Special forms of cell, worked with a specially prepared bichromate salt, have been recently introduced for the electric light by Mr. Lee, *High Holborn, London*. (4) Coils are inadmissible and useless with lamps. (5) I imagine it to be an ordinary small induction coil, but am not sure. Shall I make inquiry for you? Perhaps an illustrated description of an electric gas lighter would interest other readers. Improvements in apparatus for domestic electric lighting have been made since I wrote on the subject in an early part of AMATEUR WORK.—G. E.

Cement for Grotto Work.

MAN JACK sends the following formula for a good cement for grotto work:—Take two parts of white resin, melt it clear, add to it four parts of beeswax, when melted together add stone flour made of the stone you design to cement; two or three parts, or so much as will give the cement the colour of the stone. To this add one part of flour of sulphur. First incorporate all together over a gentle fire, and afterwards knead it with your hands in warm water. With this cement the stones after they are well dried, and have been dried before the fire, in order to receive the cement the better,

Pattern for Lathe Standard.

STADT DRESDEN.—In answer to your query on lathe standard patterns I may say that there will be no bending of timber required. The best and cheapest plan will be to work the segments and lay and fasten the facing on afterwards. In making the pattern the framework ought to be half lapped together where joints are necessary.—A. J. S.

[In reply to your queries received since the above was written, you can make your lapped joints secure by gluing them with Le Page's Carriage Glue, and screwing them together as well. In each separate piece the grain should run in the direction of its length. Mr. Scott is now engaged on a series of articles on pattern-making, which will prove of assistance to you, and help you in making any pattern whether large or small.—ED.]

Etching on Glass.

J. L. (*Weymouth*).—You will find full instructions for "Etching on Glass," in Mr. A. S. Soward's paper under this title in Vol. III., page 27 (or Part 24).

Jointing Corners of Fretwork Boxes.

ADAM BEDE writes:—"An easy way, and also a very effective and ornamental way, of joining the corners of fretwork boxes is to saw out the sides and ends from one piece;

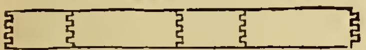


DIAGRAM SHOWING MODE OF JOINTING FRETWORK BOX CORNERS.

or, if too long for saw, from two pieces of wood, in this manner. Fold together, glue, keeping in position by cramps or with string, and finish off with rasp, file, and sand-paper."

Repetition of Instructions.

ADAM BEDE.—When a correspondent asks a question on a subject that has been already treated in AMATEUR WORK, I must refer him to the place where he will find the information sought for. I do this as completely as I can, by referring not only to *volume* and *page*, but to *part* as well, so that if my correspondent is not possessed of the part, he can buy it for 6d. To repeat instructions that have been given in another place would be to sacrifice a great deal of space to little purpose, and I should have subscribers from the first protesting against "twice told tales." Try to obtain all the back parts which you have not got through our Sale and Exchange Department. I think you will find it worth your while to do so. I am obliged to you for your contributions to "Amateurs in Council," and hope to hear from you frequently.

Magic Lantern.

LINDUM writes:—"I was very glad to see in our last Number a request for a description of a really good magic lantern. I should have been very glad some time since to have met with instructions in the matter as I long wished for a good lantern, and at last set to work and made one from my own designs, not being able to even look at one, 'as I live in a small village.' My lantern is a biunial body of polished mahogany, front sliding tubes to carry the lenses of brass. It is fitted with double achromatic front lenses, and double 4 inch condensing sliding diaphragm in front, to produce the rolling curtain effect, and is fitted with the limelight. This last I had great difficulty with as we have no coal-gas available, but am now using a modification of Pumphrey's vaporizer, which works well and gives a good light. The screen I use is made of calico covered with paper, and by means of elevators can be put up in a few minutes without a ladder, and the whole affair can be set up ready for showing in thirty minutes or less. I am afraid I have not sufficient skill with pen and pencil to properly describe it or would gladly do so, but any information as to where I got my fittings, etc., shall be freely given. If you think this will serve to encourage any brother amateur, please use it. I might say that my trade is that of a journeyman plumber." [Thank you for the newspaper cutting giving a notice of your lecture.—ED.]

Type and Rollers for Printing Press.

KILMARNOCK.—I should say that to procure amateur founts of type you could not do better than send either to the "Model" Printing Press Company, *Ludgate Circus, E.C.*; or the Birmingham Machinists' Company, Parade Iron Works, *Birmingham*, either of which firms supply small founts of type at reasonable prices. I have had several transactions with the last-named firm, and can thoroughly recommend them for their promptitude and courtesy in connection with the smallest order. As regards the roller, which you wish to procure, it can be had from either of the above-named firms, and I would advise you to get it new, as a secondhand roller is generally worthless, and utterly unfit for an amateur, or ever a professional printer to use. An article is in the Editor's hands at present on how to add a self-inking attachment to the press described in a previous number, and also how to make and cast rollers.—FAUST.

Electro Motor for Launch.

W. H. C. (*Highgate*).—The motor should be capable of developing at least a two-man power, and should be worked with current derived from a set of patent accumulators charged with a dynamo machine. The probable cost would not be less than £20 for plant, plus cost of charge for accumulators every time they need changing. Estimates for this kind of work may be obtained from The Electric Apparatus Company, Limited, 60, *Queen Victoria Street, E.C.*—G. E.

Removal of Glue from Cabinet Work.

G. M.—I must confess that I know of no liquid which can supersede the chisel for removing superfluous glue that has hardened on the work, but labour may often be saved by doing so before the glue becomes hard. Indeed I may safely say there is none. Water, however, especially if hot, will dissolve glue, and you might try if you can manage with it. I should advise you to apply it to the little bits of glue with a *very* small camel-hair brush *very* carefully. No doubt, after a few hours' work daily for a few weeks you will find most, if not all of the glue you want to remove has disappeared, and the work will perhaps look nearly as clean as if you had used a chisel. On this point I am, however, open to correction, never having tried the plan I suggest. Life is too short, and I am quite satisfied with the chisel, *Nihil sine labore*; but it is just as well to make the labour as slight as possible, and this may often be saved by removing the glue before it becomes hard.—D. A.

Cabaret Battery.

CASENHEM.—If the jars have not been shaken, or the water disturbed in any way, the blue tint of the sulphate of copper ought to come about half way up the jars, just touching the zinc. But it would not matter at all if it were one inch above or below. I must say, however, that the more the zinc plunges in the blue solution, the quicker it will be eaten up, and also the stronger the current will be.—PROF. L. M.

Scraper for Cleaning Grease Traps, etc.

BOUGWAN writes:—"Some time ago there appeared in 'Ours' some ways of utilizing old tins; but, as I do not remember seeing

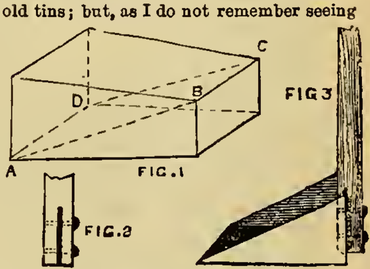


FIG. I.—TIN MEAT CAN. FIG. 2.—SAW KERF IN END OF HANDLE. FIG. 3.—SCRAPER COMPLETE.

this one, I send you the accompanying sketches. Fig. 1 represents a wedge-shaped corned beef can—a 1 lb. one is the best size—which is cut along the lines A B, B C, and C D. A handle with a saw kerf, as shown in Fig. 3 is then attached, with two screws, as exhibited in Fig. 2, which represents the thing complete. It is very useful for cleaning out cesspools, grease traps, and such like places, and I expect could be used for many other things if required. I find a handle of about 5½ feet long, just cut off an ash or hazel tree, a very serviceable kind."

Prize Fret Cutting.

J. W. (*Stoke*) writes:—"I noticed some two or three months back on the wrapper of AMATEUR WORK that Messrs. Harger state that their designs obtained nearly all the prizes at the Leisure Hour Exhibition at Burslem last October. No doubt you will be glad to know that one of my friends obtained the *First Prize* of £2 by cutting out the pattern for fretwork Epergne given in Vol. I. of AMATEUR WORK. It was done in white holly."

Slide Rest.

DIOMEDES.—You will find instructions for making a slide rest in Chapters VII. and VIII. of "Lathe Building for Amateurs," by the Rev. James Lukin, Vol. III., pages 374 and 398 (Parts 31 and 32). It is satisfactory to learn that you have succeeded in making a good lathe from OLLA PODRIDA's papers on this subject.

Violin Making.

Bee.—Mr. E. Heron Allen's papers on this subject appeared in Vols. I., II., and III., of this Magazine.

Hannam's Harvest Cart.

J. S. B.—I will, if possible, reproduce in the pages of this Magazine, the description of the above named cart from the source you mention, but I must first obtain permission to do so. If I am allowed to give it, I trust that the description will be of use to you in your new home in New Zealand, as you tell me that you have arranged for Amateur Work to be forwarded to you. I am glad to find that your "Waterbury" gives satisfaction.

Index to "Amateur Work," Vol. I.

S. J. E.—The shortest and easiest way to procure Index to Vol. I. of this Magazine is to purchase Part 12, in which title page and index to Vol. I. is included.

Darkening Oak by Fumes of Ammonia.

Bee.—A simple way, and one which I have often used with success, is by fixing up the new oak in a stable for a few months.—M. M.

Articles on Bookbinding.

H. W. W. (*Bournemouth*).—You will find the information you ask for given in reply to Caw-Caw, page 331 of this Volume (or Part 54), which in all probability you will have seen before this meets your eye.

Fret Sawing Attachment for Lathe.

E. S. D.—Thanks for your testimony to the efficiency of the machine. But you do not seem to have interpreted the design of the Spanish windlass aright. The twisting of the cord must be done before the saw is clamped in place, in fact, it is an impossibility to do so after. The object of the slot and spring is to obviate the necessity of adjusting the tension at each change of the saw. As to the bellows, the leather should be cut 7 inches long, and not 6¾. The neat length is 6¾ in., and if the lap is ¾ of an in., and ¼ in. allowed for stretching, that gives ½, or half the lap of the two ends over the neat length, seeing that it takes two ends to make a lap. There is, according to you, a mistake of a ¼ inch in the article. My parts are now being bound, so that I cannot refer back, but it is evidently a case of "quits."—Olla Podrida.

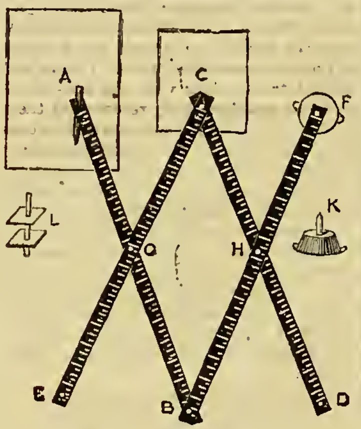
Screw-Driver.

S. writes:—"I am surprised to find the following explanation of the increase of power in a long screw-driver from Olla Podrida, in page 286 of the present volume. 'The long screw-driver gains its power through the angle at which it may be held and worked. It it were carried in a bearing so that it couldn't "wobble" around, then its effective leverage would be no greater than a short one having the same size handle.' I venture to question the accuracy of this statement, and will tell him of an easy way of testing the truth. Let him unfasten the screw which holds together the two irons of a plane, then screw them up as tight as he can with a screw-driver with a 3 inch blade. When the screw will turn no more, let him take a screw-driver with a 10 inch blade, and use it in a perfectly perpendicular position, so that there may be no suspicion of a 'wobble.' He will find that he can still tighten the screw. There is no 'wobble' in the question. The screw-driver is a couple of levers; the fulcrum on which they work is the centre of the notch in the head of the screw, the weight being the two ends of the notch; and the explanation of the whole matter is that a long screw-driver is more powerful than a small one for the same reason that, *cæteris paribus*, a long lever is more powerful than a short one."

INFORMATION SUPPLIED.

Pantograph.

H. P. A. (*Watford*) writes in reply to J. S. (*Redditch*):—"To make a pantograph, first take four flat sticks of equal length—size or material does not matter—and plane them up true and smooth. At an inch from each end of the sticks bore a hole just large enough to hold a piece of brass or other tubing, whose internal diameter is that of a pocket pencil. Into one end of each stick fit a section of the tube, opening the edge as in eyeletting, to prevent the ring so made from slipping out. Take a pair of the



SKETCH OF PANTOGRAPH.

sticks, and hinge them together at the ends which have not been so treated with a piece of tube, eyeletting as before. Hinge the other pair together in the same way. Now take a block of wood, of any shape you please, but not more than 2 inches across; bevel it round its upper edge, and through its centre, from the back, drive an inch screw whose threaded part will just fit into the holes in the sticks. For the tracer or style, take a similar screw, and cut off its head by filing the smooth part down to a point. Slip the screw into the hinge of one of the couples, and keep it in its place by a leather washer above and below, making the distance between the under side of the wood and the point exactly that of the thickness of the block. Now get half-a-dozen ½ inch round-headed dresser hooks, and put the apparatus together, as shown in the diagram, where B and C are the points at which the sticks are hinged. Slip one of the legs over the block F and screw it down so that it will move freely with a leather washer. Place the leg C D under F H, and screw it into position from the upper surface with one of the dresser-hooks. Place C E over A B, and screw it into place with another hook from above. The third hook is beneath the apparatus, close to B; the fourth beneath, close to A; and the fifth and sixth are used to screw the block on to the drawing-board, and are put in on the bevel, so that their heads will not project above the face of the block. The tracer is screwed, point downwards, at C; the pencil is at A and pencil-tracer, block, and hooks at A and B are all of equal length, so that the machine moves evenly over the drawing-board. To enlarge the drawing, the distance from F to C must be less than from F to A; to reduce the drawing, the distance must be greater, which is done by putting the tracer at A and the pencil at C. In shifting the pencil, move the hook which is put close by to steady it with it.

Chromograph.

F. R. (*Driffield*) sends the following recipe for making chromograph for the benefit of J. H. W. (page 288) and others:—Russian glue, 1 part; glycerine, 4 parts; sulphate of baryta, ½ part; the parts are to be taken by weight. First soak the glue in water until thoroughly saturated—about twenty-four hours ought to suffice; then melt up, stirring in the other ingredients.

J. C. H. (*New Basford*) writes in reply to J. H. W.:—"I have made a chromograph from the following composition, which works admirably: 1 lb. of glycerine, 6 ozs. of best Russian glue, 8 ozs. of water, 1d. of prepared chalk. Dissolve the glue in the water slowly, *do not boil it*, pour into a large basin, then add the glycerine and chalk. Stir well for five minutes, then put the lot, basin and all, into the oven to keep warm until the pan or tin is cleaned ready for the mixture, which must now be emptied into the tin, then put into a cool place, and must not be shifted for at least three hours. Before the mixture is shifted, skim off the top all the scum and air bubbles which may arise. Always wash off the ink with warm water. I have one by me that has been made now for eighteen months, and is as good as when made."

Walking Sticks of Steel Ribbon.

J. P. writes in reply to Lex:—"I doubt whether these would answer for camera stands. At anyrate, it would be difficult to attach them rigidly to the tripod head. A stand has just been brought out by Mr. Stanley, which shuts up in a short enough length to go inside an ordinary portmanteau."—J. P.

Medium for Making Photographs Transparent.

T. S. S. (*Tulse Hill*) writes in answer to J. S. (*Redditch*):—"A halfpenny paraffin candle is a splendid medium after placing the photograph on the glass in the usual manner, allowing it to dry. Heat the glass and apply the candle, and then remove the superfluous paraffin with a rough cloth.

Magic Lantern Slides.

F. R. (*Driffield*) writes in reply to R. J. S. (page 144):—"If you will refer to Vol. II., page 542, of this Magazine, you will find there described a method of making magic lantern slides from prints, etc., which I think ought to suit you."

Norwegian Gimlets.

W. T. P., in reply to GOLDSMITH, sends the following extracts from the "English Mechanic," of Feb. 12th and 19th, 1886, with a tracing from the same source, reproduced in the accompanying engraving:—"I send the sketch of the Norwegian gimlet as promised. Don't let anyone suppose from my imperfect sketch that it is only the English twist without the screw point; it is superior in every way, though the make is rough, and the steel very poor stuff. Like many other things the proof is in the eating, for these gimlets *cut* and *swallow* their food, while any English ones I have ever seen, whether shell or twist, or screw, only bruise and break the wood; the shavings getting so crowded in the narrow channel provided for them, that they either split the wood if thin, or else if thick and hard, prevent the tool entering

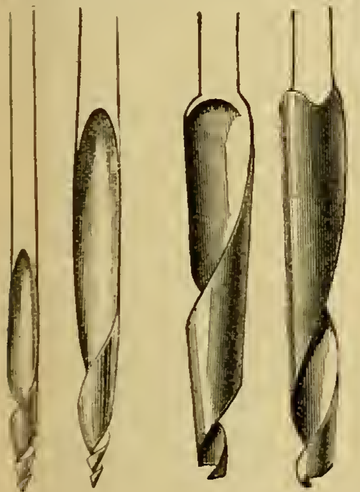


FIG. 1. FIG. 2. THE
FRENCH GIMLET. NORWEGIAN GIMLET.

further until they are cleared out. The one I have drawn is about $\frac{3}{8}$ inch: it can be worked up to the shoulder in hard wood with less labour than the $\frac{1}{4}$ inch of ordinary make. If you want to go deep, it must then be cleared of its shavings, and for this purpose, *half a turn* back lets it come out perfectly free without any of the tugging there usually is. They are made of all sizes, from 2 inches down to $\frac{1}{8}$ inch. The larger sizes are used for boring holes down the centres of straight pine trees, to convert them into the water pipes so commonly used in the country to bring the water often from long distances to cottage doors. I have seen these large augers with shanks 10 feet and 12 feet long, with lengthening pieces, to enable a tree from 30 feet to 40 feet to be bored out. But only in one out of the way little place in a little shop where things of every sort—hardware and software—were sold, did I see the gimlets, and much do I regret I only bought a couple. (Signed) "FREDERICK CARRE."

Feb. 19th, 1886.

"These are not peculiar to Norway. I constantly buy them in Paris, where they say they come from Germany. They have the point in addition to the cutting scroll, shown in Fred Carre's diagram. This correspondent will be pleased to learn that he can replenish his tool chest at Addis's, in *Leicester Street* (under the name of French gimlets); but they, curiously enough, are supplied with them for sale to the French theatrical scene constructors in London, who use them as handscrews to fasten their temporary constructions together. There is no question, however, that for gimlet uses they are very superior to any pattern gimlet known to the trade in England, as they will go through the hardest or the thinnest woods without splitting them. "MONTEMARTE."

[S. C. R. also supplies the above information in an abridged form. As the source from which it is obtained is so plainly indicated, and as the object in view is to disseminate knowledge which will be useful to many, and which might not have come under their notice in the "English Mechanic." I trust the proprietors will hold me excused for giving the above extracts verbatim instead of dressing up the gist of them in a *quasi* original reply.—ED.]

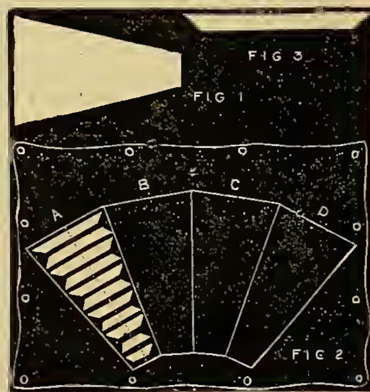
J. F. F. (*Galway*).—Thank you for your cuttings from the "English Mechanic" on this subject. I note your wishes with regard to instructions on making a magic lantern.

E. J. S. (*Bristol*) writes in reply to GOLDSMITH:—"I learn that the Norwegiau gimlets are made in sizes from 2 inches to $\frac{1}{8}$ inch, and that trees from 30 feet to 40 feet are bored out by their means to convert them into pipes to convey water to the cottage doors in Norway. In this case the shanks are from 10 feet to 12 feet long, and lengthening pieces are added from time to time as found necessary. They are credited with never splitting the wood, however thin, and of entering hard wood with as great ease as ordinary ones do into soft wood, but they do not appear to be obtainable in England. I was referred to Mr. W. Addis, Ironmonger, 6, 7, and 15, *Leicester Street, Leicester Square*, where I was told I could obtain them under the name of French gimlets, and sending for samples sketches Figs. 1 and 2, the smallest, $\frac{1}{32}$ inch, and the largest, $\frac{1}{4}$ inch, illustrate what were sent me, price 2s. 6d. per dozen, not quite so well finished as most you buy, and fitted with the usual boxwood handle and brass washer and riveted. I must confess that I was disappointed when I first saw them, but after trying them on the first piece of wood handy, I found they enter with much less labour than the ordinary kind, and I do not think they are so likely to split thin wood, but they cannot be relied on never to do so. You will notice they differ from the so-called 'Norwegian' gimlet, which has much more the appearance of an auger, and of which I send you a sketch." [The sketch is similar to that given in col. i. of this page. On comparing the sketches of the *French* gimlet with those of the *Norwegian* gimlet, it appears that the distinction between the two lies in the formation of the point, and that it is this difference in form that renders the latter, especially in its larger sizes, more efficient for the purpose for which it is chiefly used, namely, for boring holes of considerable length and diameter, and the former for the purpose of the French stage carpenters in holding together the component parts of built-up scenes.—ED.]

J. B. (*St. Peter's, Kent*) is thanked for cutting on this subject from, "English Mechanic."

Kinnear Bellows.

LEX writes:—"Shortly after I wrote to AMATEUR WORK asking how to make a 'Kinnear' bellows for camera, and prior to receiving the kind reply of C. C. V., I was thinking over the matter, and hit upon the following way: I first cut out a piece of cardboard (Fig. 1), making it the dimensions of one side of the required bellows. I then got a piece of black twill, and pinned it to a drawing-board, laid Fig. 1 on it, and by its assistance described A B C and D (Fig. 2) in chalk. I then cut strips of cardboard (two sheets) like Fig. 3, the angles being more acute than 45°. I made one set first



KINNEAR BELLOWS.

Fig. 1.—Shape of Side of Bellows in Cardboard. Fig. 2.—Black Twill on Drawing Board. Fig. 3.—Shape of Strips of Cardboard.

(each strip $\frac{1}{4}$ inch wide), and cut all the rest by them. One set I pasted on Fig. 2, as shown at A portion; but I left half of each strip unpasted, for reasons afterwards to be explained. The other set of strips were then pasted on B C and D, taking care to have each $\frac{1}{8}$ inch apart. When the paste was set, I cut the calico straight along dotted line, and left enough on opposite side D, to wrap over this, and pasted down. This prevented four thicknesses of the material coming at the corners. The strips were now on outside. I now pasted on the leather, taking care not to have the joining on piece A for obvious reasons. When dry I folded it, and the bellows is a most satisfactory one."

Ticket and Show Card Writing.

C. P. W. writes in reply to ASPIRANT:—"Messrs. Clements, Newling, and Co., 97, *Wood Street, Cheapside, London, E.C.*, supply the ink readily prepared for ticket writing; also, brushes and cardboard in large or small quantities. This house is extensively patronised by the drapery trade, who do most of their own ticket writing."

Case for Music Type.

W. F. (*Lee*) can buy a pair of music cases as cheap as he can make them, as they are manufactured in large quantities by machinery; a pair could be obtained of Sir Charles Reed and Sons, *Fann Street, Aldersgate*, for about 15s.; if, however, W. F. would rather make them himself, I shall be pleased to give him the desired information, either direct or through these columns, if the Editor considers the subject of sufficient general interest. Has W. F. seen the new music type manufactured by Jabez Francis, of *Rochford*; this arrangement renders music printing from types very simple, and the work is much cheaper and quite as effective as that printed with ordinary music type.—G. L.

Wheels for Electric Clock.

Lex writes :—"Seeing many inquiries asked where wheels, etc., for electric clocks can be procured, I wish to let my brother amateurs know that they can get them unfinished for 5s., or finished beautifully and fitted with tubes, pinions, etc., for 14s. 6d., at Messrs. Grimshaw and Baxter, 33 and 35, *Goswell Road, London, E.C.* The latter price includes pendulum. I cannot speak too highly of the beautiful way in which the wheels, pinions, and pendulum I received from them are finished.

Ornamentation with Moths' Wings.

W. J. P. writes :—" If Mad Jack takes a piece of thin tissue paper, gums one side of it, and lays the wings on the gummed side, then takes another piece of the paper, and, having gummed one side of it, lays it on the other piece, with the wings between; when dry, on holding it up to the light and cutting closely round the winge with a sharp pair of scissors, he will be able to separate the papers, leaving the membrane of the wing quite clear, the feathers being stuck to the papers, which can be arranged as desired."

Shoemaker's Wax.

J. T. H. writes in reply to J. L. D. (*New Quay*):—Shoemaker's wax is made by melting good pitch in an iron vessel, and adding crushed resin (one ounce to the pound of pitch), and a small piece of tallow or a few drops of oil. In very hot weather add more resin, and more grease if the weather is very cold. Melt gradually, stirring occasionally, and when perfectly liquid (it must not boil) pour into a pail of cold water, and stir with a piece of stick until it can be handled. Then commence pulling it, holding the hands well in the water to prevent scalding. Pull out and double over, repeating this for some time until the wax becomes a pale bronze colour, and will swim in the water. It is then cut with a pair of shears or large scissors into balls of a convenient size, and kept in a small tub of water until wanted for use."

INFORMATION SOUGHT.

Alteration of Harmonium.

A Musical Reader wishes to know how to convert a one-manual harmonium into a two-manual instrument. He has but two volumes of Amateur Work, and if the subject has been treated of in either of the remaining volumes, he only requires a reference to the particular volume. His circumstances compel him to practise a somewhat rigid economy, or he would not ask the question.

Lapidary Work in Agates.

Lap wishes to ascertain (1) Cost and method of arming 10 inch slitting plate with diamond dust. (2) Number of "laps" needed for polishing, description of polishing powder for each, and method of applying it, and material of "laps." I have a lapidary apparatus, including slitting plate and one or two laps, made by the Britannia Company. It fits on right hand end of lathe bed, and runs beautifully at very high speed, driven by a supplementary fly wheel on shaft of the lathe fly wheel. The extra wheel is a help rather than a hindrance, and if I can get a few hints as to materials, etc. (as asked), I am sure the mechanism will be a success. The bearings of the driving pulley adjust beautifully, and there is no perceptible increase of friction on bearings even when heavy pressure is applied to laps. I have polished some pebbles, and am sending specimens to the Britannia Company. But, of course, as I have had to find out for myself what little I know, I have not been very successful. I notice a remark in Amateur Work as to amateur lapidary work, and shall be glad to assist anyone who likes to write to me so far as I can, with what I do know—viz., where to get good jaspers, agates, etc., and how to distinguish them; and if I succeed, as I mean to, in both slitting and polishing, I shall be glad to give any help I can on those points.

Market for Cut Flowers.

Tyro asks :—Can any reader inform me where I can dispose of lily blooms to advantage? I believe there is a market for flowers somewhere in London. Do any dealers sell blooms on commission; if so, any addresses will be welcomed.

Brazilian Pebble Spectacle Lenses.

Crystal writes :—"Can you or any of your readers inform me what tools are necessary and probable cost of tools for producing the different sorts of spectacle lenses—viz., double concave, double convex, periscopic convex, and periscopic concave; these I am led to understand are the only sorts produced for spectacles. The most important thing is how they are worked to produce all numbers from 4 to 60. Do the numbers mean inches, or only a trade number? Is it necessary to have four different sets of tools? It would I am sure be of great interest to many of your readers if you could spare some of your valuable space for articles on the above. The processes of cutting, grinding, finishing, and facing, I have some idea of, for plain surface such as agates for brooches and half pebbles for specimens; but what I want to know is, how are double convex, double concave, periscopic convex, and periscopic concave, produced, by what combination of tools, and how crossed to produce the different numbers or focal sights? Any information as to the different processes of the above work would be greatly esteemed." [Emphatically *I* cannot. I give your communication, but spectacle making would be amateur work *in excelsis* and "caviare to the multitude." There is a limit to everything, even to amateur work, and I think a few minutes' conversation with Mr. John Browning, 63, *Strand, London, W.C.*, who, I may say from experience, is one of the best of opticians, would convince you that to describe spectacle making would be for me a waste of space, and to nine hundred and ninety-nine out of a thousand readers a stumbling block, while to you any encouragement to proceed would, I fear, be entrapping you into great waste of time to no purpose. Try something more come-at-ible.—Ed.]

Cane-Seated Chairs.

S. J. R. writes :—"I wish to repair some cane-seated chairs. If there is no immediate prospect of a special article on the point, as is suggested in reply to F. P. last month, I shall be glad to have information through the medium of 'Amateurs in Council,' how to set about the work, and where in London I can buy materials. I fancy this is a subject which has interest to many of your readers who, like myself, try to follow the maxim adopted by Miles Standish, 'If you would be well served, you must serve yourself.'"

Harmonium Building.

Benjamin wishes to call attention to his query on this subject in Part 47 (Vol. IV., page 593), in the hope of receiving a reply.

Metronome.

Farina asks :—Can anyone give me some hints and drawings how to construct a metronome, not a very elaborate one, but one that would beat the time and strike something for the bars, and also one that could be regulated to any particular time.

Fittings for Guns.

E. N. D. (*Cardigan*) writes :—"Please say of any firms that are selling fittings ready for guns and pistols, and where to have guns and pistols new and secondhand." [Secondhand guns and pistols may be bought of pawnbrokers and sellers of unredeemed pledges in any large towns. Marine store dealers have weapons of this kind to dispose of occasionally. New guns and pistols may be obtained of or through any ironmonger in the country. If you wish to apply to any London gun-maker, write to Messrs. E. M. Reilly and Co., *Oxford Street, W.C.*, who will supply you with anything of this kind you may require. Lastly, if you wish to make a stock for yourself, and get the lock, barrel, etc., there are plenty of gunmakers in Birmingham who *may* let you have what you want, but I am unable to refer you to any by name. Perhaps some Birmingham reader will do this. —Ed.]

LETTERS RECEIVED UP TO MAY 17.

[*Replies to these in Next Part.*]

Ursus; Mad Jack; Clericus; Twist Drill; Jack Pipes; Lap; Only an Amateur; W. R.; A. E. M.; Ravacar; F. W. S. (*Peckham*); C. M. (*Brighton*); R. B. (*Bedale*); Stadt Dresden; Rover; Esor; Indebted; Diomedes; Artist; J. H. B. (*Penzance*); A. B. C.; Model Engine; A Railway Man; N.E. Signalman; Madera Negra.

D.—Cover of Box, below Looking Glass. Of this one only is required.

A.—Frame for Glass.

C.—Frame with circular hole to take Japanese China Cup. Out two of these.

E.—Support for Glass, forming side of Receptacle for Drawer. Cut two.

F.—Hole for pin to carry Glass.

B.—Piece to left of Glass. Cut one.

B.—Piece to right of Glass. Cut one.

G.—Fretwork Panel below Glass.

WARD, LOCK, AND CO., WARWICK HOUSE, SALISBURY SQUARE, LONDON, E.C.

ORNAMENTAL CUP FROM A COCOA-NUT.

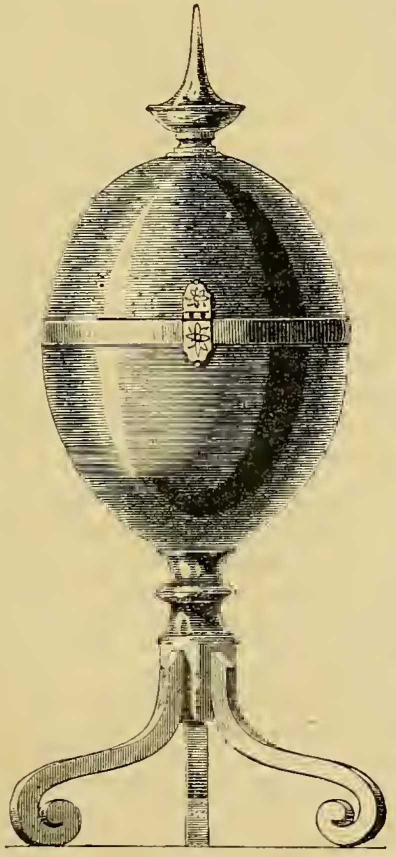
By WALTER J. HOLROYDE.

THINKING that many amateurs like myself would be glad to try their hands at something a little out of the common, and knowing, as I do, from experience, the charm of variety in connection with amateur's work, I venture to call to your notice a method I have lately employed of utilising a very common article, viz., the shell of a cocoa-nut, and have succeeded in making from the same some exceedingly pretty cups or vases, that as well as being ornamental, are extremely useful for such purposes as holding tea, sugar, tobacco, or many of those nameless odds and ends that are always laying about the house. Also, by cutting the nut in half in the direction of its length, it can be converted into two very pretty stands for cut flowers. The method I have adopted is to cut the shell in two with a fine dovetail saw, bind the edges with a thin strip of sheet brass, hinge the two parts together, and mount the shell on a brass stand. The general effect will be seen on reference to the accompanying sketch.

A few practical remarks on the *modus operandi* may be of use to those who wish to try work in this somewhat brittle material. The first operation is to clear the nut of its outer skin or bark. This is best done with a chisel and spokeshave (but if the latter is of wood it will suffer much in the operation), then smooth up with file and glasspaper to a good face.

Next, having decided upon the exact point at which you will divide the shell, the first difficulty arises in marking a line to saw by that will leave the joint perfectly level when it is mounted; this and the marking out of the two points at the top and the bottom of the nut wherein to fix the top ornament and the stand, will most puzzle the amateur, as no two nuts are of the same exact shape, neither can they be reduced to any precise mathematical form. I find the simplest method of over-getting this difficulty (provided the operator possesses a lathe) is to temporarily fix the nut in the centres until it revolves nearly truly to the eye, and then to hold a lead pencil opposite the point it is wished to divide it at, and follow the mark all round, turning the nut in the centres by hand, saw while the nut is still in the centres, and bore the holes for top and bottom attachments at the places indicated by the lathe centres; this will ensure a satisfactory result.

Should no lathe be accessible, I would then suggest placing the nut on its end on the bench or table, selecting a piece of wood or books that will reach the required height, and then holding the pencil on these as a rest, turn the nut carefully round, pressing the pencil point to the surface as it rotates, then saw to the mark; but in any case only saw *a little at a time*, going thus all the way round, do not attempt to saw right through at once, then remove the kernel.



ORNAMENTAL COCOA-NUT CUP.
HALF FULL SIZE.

A thin strip of sheet brass must now be prepared and filed up and polished to rivet round the edge of the joint on the lower section of the nut. Great care is required in this operation, as the shell is so brittle that it easily breaks. I prefer boring each hole, tapping the same, and cutting a thread on the attaching wires or rivets, so as to avoid all danger from the blows of the riveting hammer.

This plan takes time, but it saves much annoyance from breakage. The top can be ornamented by any design that may be to the taste of the maker, such as a spike, acorn, etc., etc. The same may be said of the stand. A few suitable patterns are within the power of most amateurs to make, and can be had cast at the brass-founder's for a trifling cost; these can be either soldered, pinned, or brazed together after they are got up, and they form a very elegant support. It now only remains to French polish the shell, and you have a very nice ornament indeed, fit to set off any room.

Now that brass work is so much in vogue, I think the result will amply repay all the trouble of making, and the expense is merely nominal, provided the amateur has the necessary tools to carry out the work. If, however, he has to buy a tool or two to provide for present need, he becomes possessed at once of the means to carry out all work of a similar kind.

METAL ORGAN PIPES:
HOW TO MAKE THEM.

By MARK WICKS.

II.—REED PIPES.

IN my last chapter, I gave my reasons for supposing that the generality of amateurs would not gain much by trying their hands at metal pipe making. These reasons apply with ten-fold force in the case of reed pipes, in which the speaking part requires such delicate work and entails so much patient perseverance to secure satisfactory results, that I am afraid many who attempt the task will fail. Moreover it is very difficult to give written instructions as to this most important branch of the work ; but, so far as is in my power, I will endeavour to make the matter clear. In order to give the amateur every facility I have carefully drawn the accompanying sketches on a large scale, and I trust that a careful study of the drawings and instructions will supply all that is required to enable the amateur to understand what is to be done.

It must first of all, be pointed out that the reed pipes have no mouths like flue pipes, and that the pipes themselves play quite a secondary part in deciding the tone of the note given. The real speaking part is a metal tongue somewhat like the tongue in a concertina or harmonium reed. This tongue, if properly adjusted, and wind forced against it, vibrates in or against an opening cut in a small brass tube called a reed: the length of the vibrating portion being regulated by means of a bent wire which presses the tongue against the reed. The lengthening or shortening of this vibrating part decreases or increases the number of vibrations, and accordingly the note obtained is proportionately lower or higher in pitch. The reed and tongue are fixed in a hole in a block of wood or metal, and the whole affair is enclosed in a sort of pipe foot which is termed a *boot.*

If we now place a short pipe over the hole above the reed, and test the sound, we shall find that the note obtained is of the same pitch as without the pipe, but that the tone is different. So, according to the length, scale and shape of the pipe, we may obtain a variety of tones from the same reed ; but the tone can also be modified by manipulating the tongue of the reed.

Having thus in a measure cleared the way, I will proceed to describe the several parts of the reed pipes. Fig. 17 is a view of a wood block, and it will be seen that it is merely a square piece of wood, the lower portion cut smaller than the upper, so that it will fit into the boot, and a portion of this lower part cut right away. A hole is bored through it the size of the reed, but it will be observed that this hole is made nearer to the back of the block than to the front. Another much smaller hole is bored through near the front through which the tuning wire will pass. In Fig. 18 the block is shown so that we may obtain a view of its under-side, and the reed and tongue are shown in position. A is the block, B the lower portion of the pipe fitted into the hole in the lower part of which is D the reed, and E the tongue. The tongue and reed are kept firmly in their place by means of a wedge F, which fits into a notch cut at the side of the hole in which the reed is placed. The tuning wire C is also shown. Passing on to Fig. 21 we have a section of the wood boot with the reed block fitted into it. G is the boot, and H is a small wooden foot or tube through which the wind passes into the boot. This boot is merely a square box of thin wood and may be about 6 or 7 inches long, but the width will of course vary with the size of the block. Figs. 19 and 20 give respectively a view and section of the metal block, and the upper part of the boot. Metal is generally used now, but formerly wood was almost exclusively the material for blocks and boots of reed pipes. Amateurs will probably be likely to succeed best if they make these parts of wood, as metal blocks must be cast, but the pipes may, nevertheless, be of metal if desired. In order to avoid confusion, I have lettered the sketches so that the same parts are indicated in each sketch by the same letter.

There are two kinds of reeds used in organ-pipes, and they are shown in Figs. 24 and 25. The first is termed the OPEN reed, and the second is called the CLOSED reed. They both consist of a tapered brass tube, open at the top or small end, but closed at the bottom or large end by means of a piece of brass soldered on, and this bottom piece, as will be seen by the section (Fig. 30) is usually sloped so that it is rather higher at the back than at the front. In the open reed the entire front is filed away as shown in Fig. 34, and the edges must be perfectly smooth, straight and true. In the closed reed only the lower portion is so filed away, so that a conical opening is made as seen in Fig. 25. The exact size of these openings depends on the particular stop for which the reed is intended, and also on the individual taste or caprice of the maker, but the edges MUST BE TRUE.

No definite rule can be laid down for the exact sizes of any of the speaking parts of reed pipes, as nearly every builder uses his own scales, the only thing necessary is that whatever scale you decide to adopt should be strictly adhered to throughout the several stops. For loud and full-toned stops the opening in the closed reed should be longer and wider than for quiet thin-toned stops ; and, of course, if an open reed is used, the width of the opening is

regulated in the same way. The length of the reed is generally computed at $\frac{1}{2}$ inch for each foot in the *tone length* of the pipe. Thus for a 4 feet pipe the reed will be 2 inches long, for a 3 feet pipe $1\frac{1}{2}$ inch, and for an 8 feet pipe it will be 4 inches. This refers to the speaking length of the reed, or more properly to the part of the reed visible below the block. Consequently we must allow an addition to the length of the reed according to the size of it, so as to admit of its being firmly held in its place in the block. For a C C reed we may allow about $\frac{3}{4}$ inch extra length, while for the smallest (top G) we may allow about $\frac{5}{16}$ inch, the total length of these two reeds will be $4\frac{3}{4}$ inches for C C, and about $\frac{3}{4}$ inch for top G. Now as regards the diameter of the reeds, C C may be about $\frac{6}{16}$ inch at the top or small end, and half as large again at the bottom or large end—viz., $\frac{9}{16}$ inch. The top G is $\frac{2}{16}$ inch at the top, and half as large again—viz., $\frac{3}{16}$ inch, at the bottom. These reeds are shown in the sketches the actual size ; Fig. 25, showing the closed reed, with an opening one-third of the speaking length, the dotted lines showing what would be the size if made two-thirds long, which is the length often used for trumpet and cornopean stops. The shaded part marked A in the top part of the reeds shows the portion which is to be inserted in the block. It is usual to make the reeds the same length and scale for all stops, any difference required being simply in the size of the opening where the tongue comes; but if amateurs like to take the extra trouble there is no objection to their having different scales for the reeds of different stops. A scale showing the length and the two diameters of each reed can easily be made by following the same system as in making a scale showing the length and two diameters of a wood pipe, using, of course, the dimensions given in the present article.

We now have to deal with the tongues, the vibrations of which, in or against the reed, produce the sound. They are simply strips of very thin well-hammered brass cut nearly as long as the reed, and the making of these is a very delicate piece of work. Reeds sub-divide themselves into two classes—viz., free reeds and striking reeds. Free reeds are so termed because in vibrating the tongues pass right into the opening of the reed, whilst in the striking reed the tongues strike on the edges of the opening, but do not pass into it. The surface of the reed where the tongues strike is generally covered with leather in order to prevent harshness of tone. It will, therefore, be understood that the length and width of the tongue is affected by the conditions above referred to.

To make the tongues, procure a sheet of thin well-hammered brass, and with the cutting tool mentioned in the last chapter, cut out a piece sufficiently wide to make the longest tongue, and long enough to cut a good many tongues side by side. In order to economise material, and save useless labour, they should be marked out so that the wide part of one comes at the top of the strip, and the wide part of the next one comes at the bottom, in exactly the same way as I have shown in the sketch in my article (Vol. II., page 25) for cutting out the wooden lips of paper pipes, only the tongues will, of course, have but very little tapering.

It must be clearly understood that the tongues must not be cut out with shears, as it would cause them to roll up, or kink, and thus render them utterly useless. We, therefore, after marking out the size of the tongues in the manner described, take our shave-hook, and placing a straight-edge against each line, firmly draw the point of the hook along the line, until the metal is almost cut through. Now look at Fig. 27, which is a portrait of a little home-made vice, which will be very useful to an amateur in many ways. The sides are made of beech, or other hard wood, and the jaws are each lined with a piece of ebony planed perfectly true. The short side is hinged to the long one by means of a piece of stout leather, and a block is fixed to the lower portion of the long side as shown, so as to keep sides parallel. The vice is opened or closed by means of the thumbscrew. If it is intended to make reed pipes longer than 4 feet tone, the vice should have two thumbscrews side by side, as it will have to be nearly 6 inches wide; but if the vice is not required more than 3 inches wide one screw will suffice. This little vice may be secured in the chops of an ordinary bench vice, or screwed to the side of the bench, or dovetailed into the top or side of it.

Now for its use. Having scored out a tongue, screw the strip of metal in the vice so that the scored line is just level with the top of the vice, then carefully break or crack the metal, and you will thus be able to separate each tongue from the sheet without bending or wrinkling it in any way. Having thus roughly shaped a lot of tongues, you proceed to finish them off. Screw each one up in the vice again, and with a little iron plane carefully plane the edges true, and make the tongue the width required. Then very carefully file each tongue down to its proper thickness, where again the matter of taste comes in. For heavy-winded pipes required to give a loud full round tone, the tongues must be rather thick and broad, but for light-winded pipes to give a thin penetrating tone, the tongues must be thin and narrow. The tongue must be *perfectly true* on the side *next* the reed, but on the outside it slopes, being made thicker at the top than at the bottom or free end.

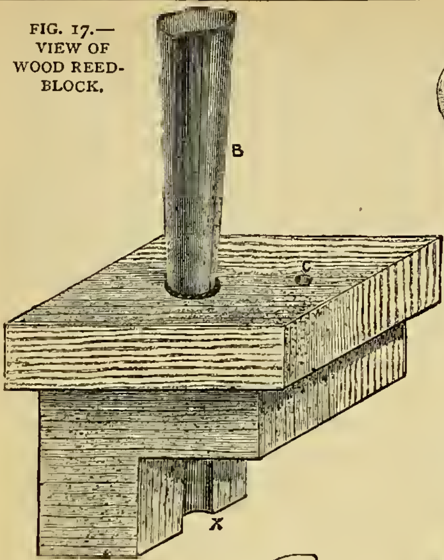


FIG. 17.—VIEW OF WOOD REED-BLOCK.

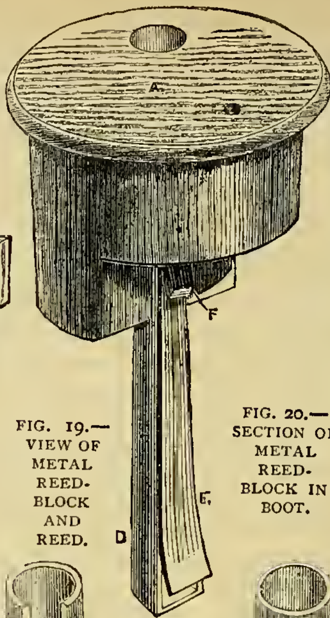


FIG. 19.—VIEW OF METAL REED-BLOCK AND REED.

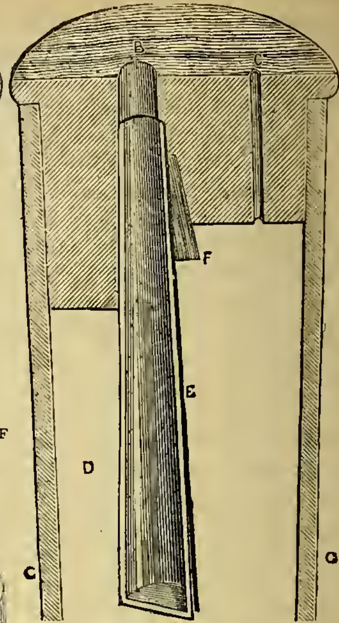


FIG. 20.—SECTION OF METAL REED-BLOCK IN BOOT.

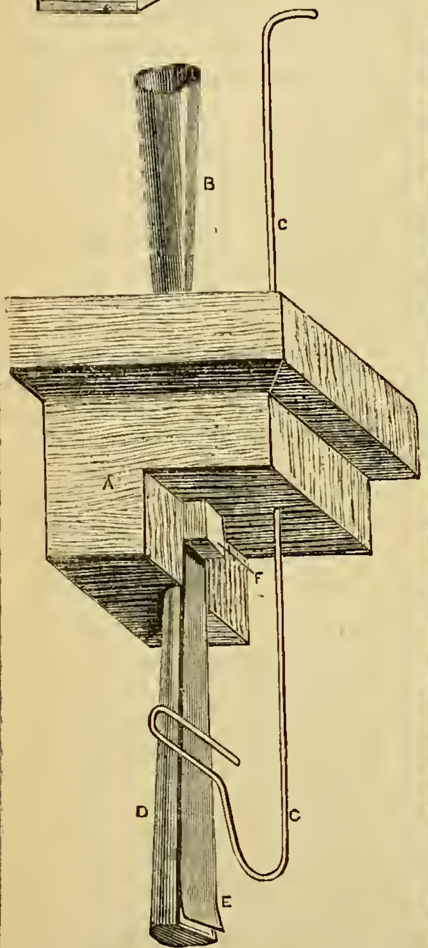


FIG. 18.—VIEW OF WOOD REED-BLOCK, WITH REED, ETC., COMPLETE.

FIG. 24.—CC OPEN REED.—FULL SIZE.

FIG. 26.—SMALLEST REED, FULL SIZE.

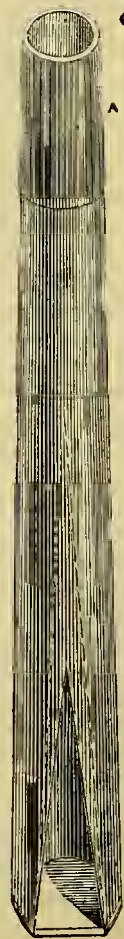


FIG. 25.—CLOSED REED.—FULL SIZE.

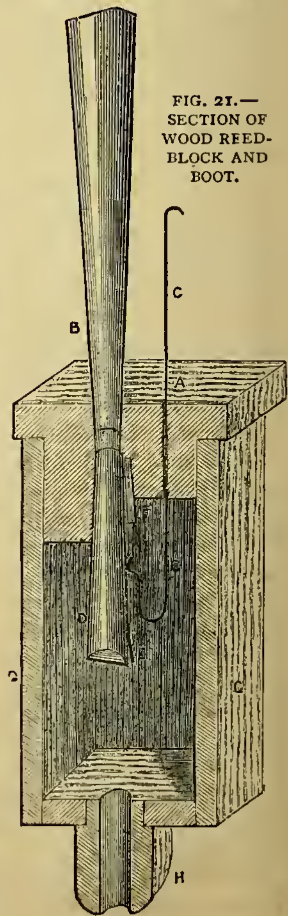


FIG. 21.—SECTION OF WOOD REED-BLOCK AND BOOT.

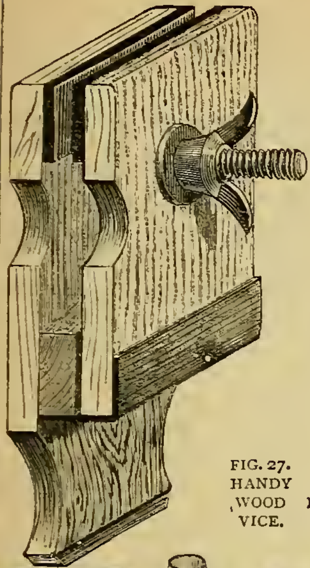


FIG. 27. HANDY WOOD VICE.

FIG. 22.—VIEW OF TUNING WIRE.

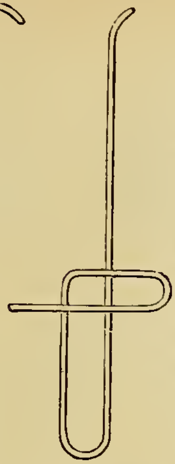


FIG. 23.—ANOTHER, WITH ALTERNATIVE BEND.

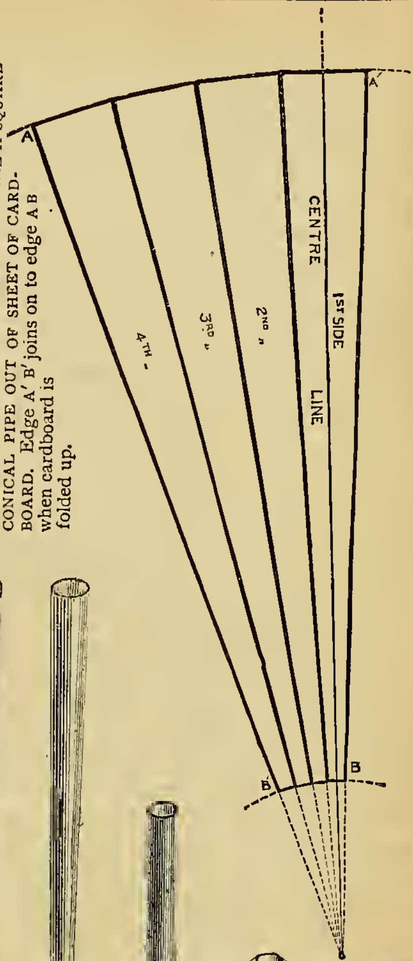


FIG. 40.—DIAGRAM SHOWING HOW TO MAKE A SQUARE CONICAL PIPE OUT OF SHEET OF CARD-BOARD. Edge A' B' joins on to edge A B when cardboard is folded up.

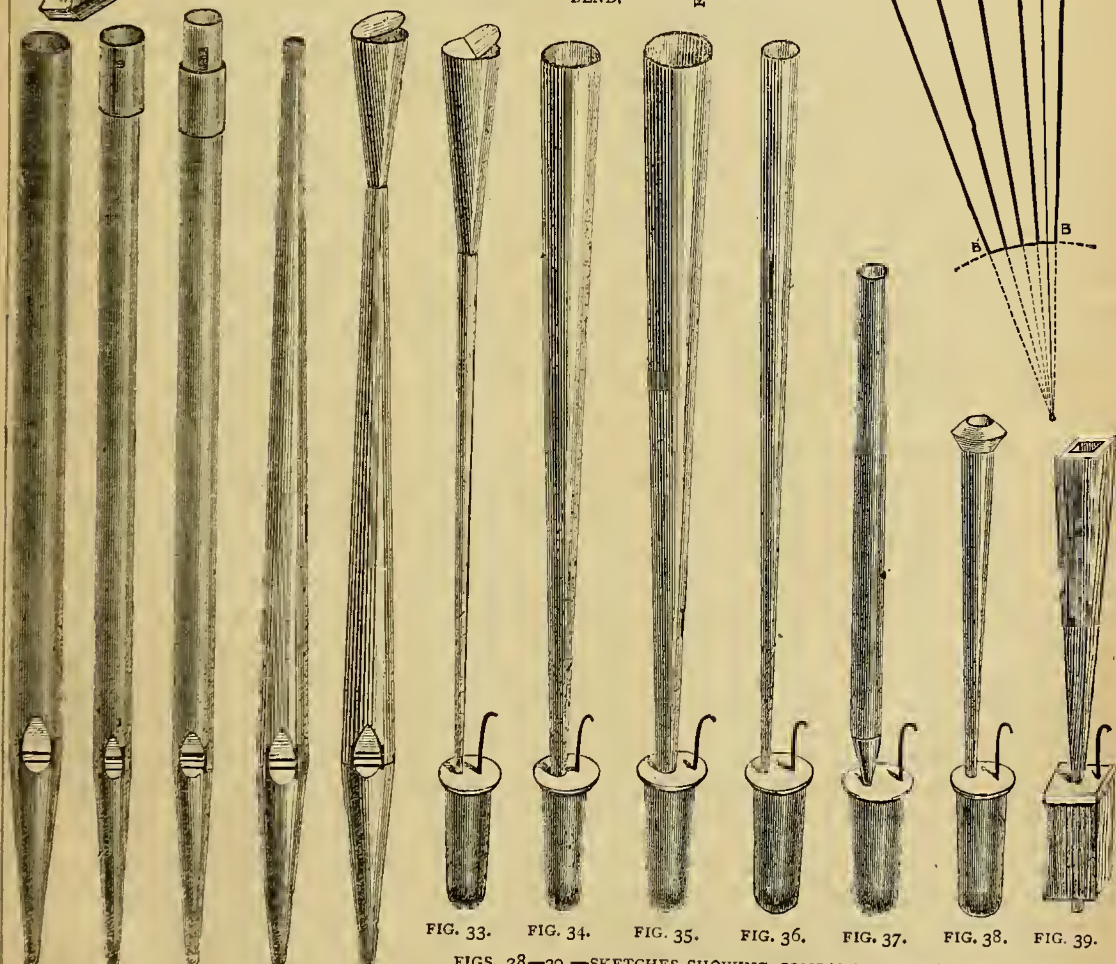


FIG. 28. FIG. 29. FIG. 30. FIG. 31. FIG. 32. FIG. 33. FIG. 34. FIG. 35. FIG. 36. FIG. 37. FIG. 38. FIG. 39.

FIGS. 28—39.—SKETCHES SHOWING COMPARATIVE SCALES OF PIPES TO SOUND THE SAME NOTE.

I do not think I can give amateurs better advice than to urge them to procure one or two complete pipes of each stop, which they propose to make and endeavour to imitate them in every part, and also in tone. If you obtain from a dealer or builder a large, a medium, and a small pipe of each stop, you will have a clear guide before you as to the size, scale, and thickness of every portion, and above all will know how your pipes ought to sound when completed. These specimen pipes need not necessarily be new ones, but, of course, they must be in good working order. One word of caution, however—on no account give way to the impulse to blow a reed pipe with your mouth, as it will most probably ruin the pipe. Always test for tone by placing the pipe on a soundboard or on a voicing machine.

When filing the tongues down let them be laid on a block of smooth hard wood, and to finish them off use a piece of the finest glass-paper stretched on a flat piece of cork. As regards voicing, I do not know that it is possible to give more definite instructions in writing than those contained in the excellent little paper by another contributor, in Vol. IV., page 409, but I may add that a round burnisher such as is sold for sharpening steel scrapers, is, in my opinion, a better and safer tool than a bradawl for an amateur to use for working the tongues into the desired curve. Now, presuming that the amateur has made his reed-block, reed, etc., and fitted the latter into the block, it must be firmly secured by means of a little wedge made of hard wood. The wedge must be allowed to project below the block so that it can be taken out easily when required to do anything to the tongue, etc.

Next, we must make the tuning wire, and in Figs. 22 and 23 you will see sketches of the wire from two different points of view. It is rather difficult to show exactly how this wire is to be bent, but if it is borne in mind that it is only the loop which touches the tongue while all the rest of the wire is kept beyond reach of the vibrating tongue, you will have no difficulty in making it. Fig. 22 is a side view, and Fig. 23 is a view looking direct on that portion of the wire which presses on the tongue. The latter figure also shows an alternative method of forming the loop. The wire should fit easily into hole in the block, and the top of it should be curved over a little, so that the tuning knife can be hooked under it when required to shift the wire.

The pipe is fitted tightly into the hole above the reed, and the size of the hole in the bottom of the pipe is therefore in a measure regulated by the size of the reed, but the hole in the pipe may often be required to be smaller than the reed. In the case of small metal reed pipes, the pipe is often soldered into the block, but in the case of large pipes, a short pipe or socket is soldered into the block, and the pipe itself merely drops into the socket.

The pipes are in most cases of a conical shape, the largest section being at the top and the smallest at the bottom. They may be made of either metal, wood, or paper. If they are to be metal the amateur must first make a scale in exactly the same way as for an ordinary metal pipe, showing the length and diameter of each pipe in the stop, and also the width of the metal required to make it, proceeding as directed in setting out a pipe-foot, as they will be merely like elongated feet. If the pipes are to be of wood they are made square in section but conical in elevation (see Fig. 39), and the wood need not be more than $\frac{3}{4}$ inch thick for an 8 foot pipe. If they are made of paper they will require to be rolled on a mandrel of the requisite shape, but it might perhaps be convenient to the amateur to make them square as for a wood pipe, in which case they could be cut out of a single piece of stout cardboard, and each angle partly cut through with a knife, so as to facilitate folding up into shape (see Fig. 40). The only joint would then be along one angle, and this could be covered with a strip of paper to make it secure and strong. The pipe could then be further strengthened by covering it with two or three layers of stout paper, so that it would look, and also really be, as practically without a joint as a circular paper pipe. Do not forget that when gluing the layers of paper a minute or two must be allowed for the glue to soak in, and the paper to stretch before rolling it round the pipe. Well rub down with a paper knife or a round stick so as to get a smooth unwrinkled surface. Pipes made in this style would only require a few mandrels, as the smaller ones could be made without them. I might add that if the stoutest Willesden waterproof paper is used to form the pipe, and a thinner variety of the same paper used for the outside layers, the pipes would not require painting or varnishing, and would at the same time present a nice appearance. One advantage of using wood or paper is that there is no danger of the pipes crushing up or breaking off with their own weight as is often the case with metal. If the metal is too soft they crush up, if it is too hard, the pipes are brittle and easily break off. The reeds themselves may be made of Willesden paper, if the edges of the hole cut in them are covered with a layer of thin paper passing round the outside of the tube, over the edges and glued down inside, so that there is no danger of the layers of paper separating at the edges where the tongue is placed.

As I daresay many of my readers would like to have a hint as to the scales of reed pipes, I have furnished a set of sketches showing their length and

scale for a Tenor C pipe, *as compared with a Tenor C Open Diapason.*

The pipes shown are as follows :—

Flue Pipes.

Fig. 28. Tenor C, Open Diapason.

Fig. 29. Tenor C, Keraulophon, 6 scales smaller.

Fig. 30. Tenor C, Slotted Gamba, 6 scales smaller.

Fig. 31. Tenor C, Gemshorn, diameter at mouth one scale less than Open Diapason, diameter at top one-third diameter at mouth.

Fig. 32. Tenor C, Viol-di-Gamba, diameter at mouth 2 scales less than Open Diapason. Diameter at top the same. Diameter at smallest part (which is one-fifth the length down from the top), one-third of the diameter at mouth.

Reed Pipes.

Fig. 33. Tenor C, Oboe. Diameter at top of widest part same as Open Diapason, diameter at joint of inverted cone (which is one-quarter the length of the pipe) one-third of top diameter. Tongue thin and narrow, and may be straight, or very slightly curved.

Fig. 34. Tenor C, Trumpet, about 2 scales larger at top than Open Diapason, tongue slightly curved.

Fig. 35. Tenor C, Cornopean. Five or six scales larger at top than Open Diapason. Broad Tongue, nearly straight, but does not lay quite close to the reed.

Fig. 36. Tenor C, Bassoon. Eight to twelve scales smaller than Open Diapason. Tongue thin and narrow, very slightly curved, and close to reed.

Fig. 37. Clarinet. Tubes only two-thirds the length of Open Diapason, and 12 scales smaller in diameter. Tongue thin and narrow, nearly straight, and close to reed.

Fig. 38. Vox Humana. Only half the length of Open Diapason, diameter of largest part of top piece the same as top of Open Diapason.

These pipes are sometimes made the same shape as the Clarinet, and of stout metal.

As a general description of these pipes was given in my previous papers on Organ Building, I must now leave it to the individual worker to provide the requisite skill and patience to carry the instructions into effect.

SOME HINTS ON CONJURING APPARATUS.

By D. B. ADAMSON.

III.—THE MARVELLOUS BIRDCAGE.

IN my last article on conjuring I promised to describe a trick which had recently been shown me as a novelty, and, I think, likely, from the construction of the apparatus, to interest readers of AMATEUR WORK. Of course, our dear friend, the Professor, would give us a private performance all to ourselves if we wished one, but, perhaps, we shall be able better to appreciate the trick if we see it from an ordinary spectator's point of view. Accompany me then, in imagination, my brother amateur, to the hall where the Professor is giving his entertainment this evening.

"All work and no play," etc., so a little relaxation from the cares and worries of even amateur work, won't come amiss. Besides, may we not hear some wonderful statements—facts, every one of them, of course—from the Professor, who, as usual, will increase our knowledge about all sorts of things—an evening devoted to instruction combined with amusement, you know—something after the old Polytechnic style, where, however, the useful information reminded us rather too forcibly of old Whackemhard's (D.D.) establishment for young gentlemen, to allow our enjoyment to be exuberant; and, to our juvenile ideas, the instruction bore a disproportionate relation to the amusement. Let us, this evening, put amusement first, and, as for useful information, why, let it look after itself. You and I, my patriarchal friend, if we can't be boys again in years will be boys again in heart, without a care or trouble in the world, while we watch the conjuror and regard him as a veritable magician. "Ah, happy years! Once more, who would not be a boy?"

Hush! here he comes. Watch him do his tricks. How clever he is; and how awfully nice it is for him to be able to get no end of gold-fish, rabbits, not to mention sweets, etc., out of empty hats and such like. Besides, what a Crœsus he must be, he just pulled your ear and got half-a-crown immediately. Then he put his hand to my pocket and got another, though I am sure there was nothing in it a minute before, at least nothing in the form of coin. Such a flow of language, so gentlemanly and affable too. Hurrah! we will be conjurors when we grow big. After we had been to the pantomime and expressed our wish to become clowns, our parents—most unreasonably—scorned the idea. Surely they won't object to our adopting the profession of conjuror.

Let us begin now. I will pull your ear and get half-a-crown. What! I pulled too hard. That can't

be, as I have not got the money; perhaps I did not pull the right way. Meanwhile, we must be quiet or we shall be turned out, as the Professor is just about to recommence after the usual interval. Let us listen to him talking—much as follows :—

"The former part of my entertainment has been composed entirely of sleight-of-hand tricks, and my intention has been to puzzle you, as, of course, no one would care to see a conjuror unless he did apparent impossibilities. For a few minutes I shall ask your attention to the small birdcage which I hold in my hands. I suppose no one can guess why I hold it in my hands now, so, as I am going to take you entirely into my confidence while giving you the history and capabilities of this cage, I may as well tell you what the reason is, and you will at once own that I am not deceiving you, though my veracity is sometimes doubted. I see 'a chield amang ye takin' notes,' so I must be careful. Hech (the goodman pronounces it hek), sirs! Well, the reason is that as the cage has nothing under it except my hand, if I removed my hand of course the cage would fall and probably be injured. No one, I think, will dispute this.

"You will notice that the cage is different from those usually made. It is, you see, only a square wooden box with wire door in front, a couple of wires at each end, and a perch inside. Nothing can be simpler, but you can hardly imagine how I pondered over this cage before I made it. First of all I had to consider what material I should use. I rejected all that occurred to me as being in one way or other unsuitable, but I will not weary you with my reasons.

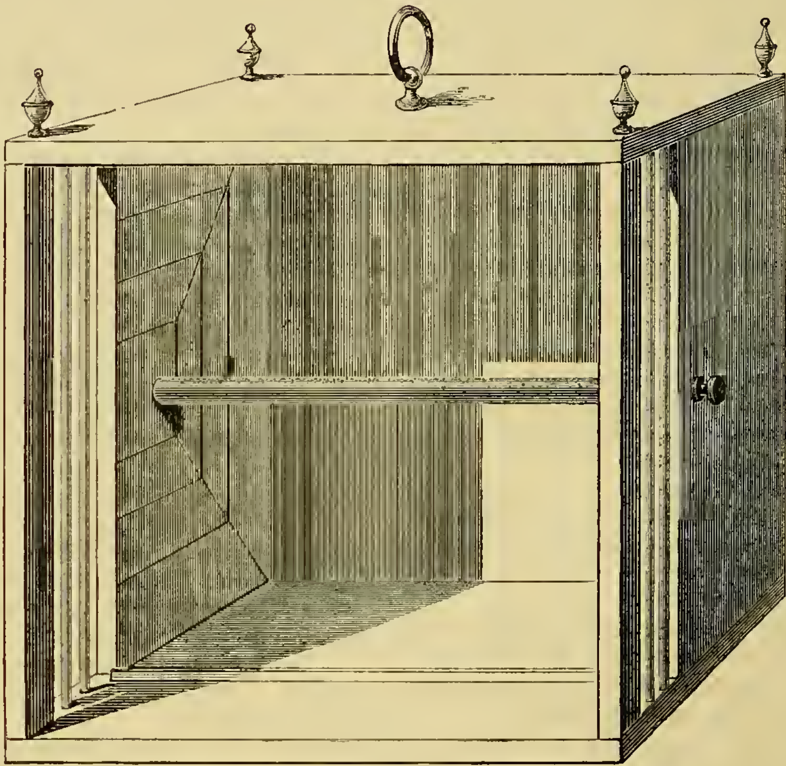


FIG. 1.—THE BIRDCAGE, DRAWN WITHOUT DOOR AND EXHIBITING INTERIOR.

"By the way, I know I am a great talker, but pity me, keyind friends, it is not my fault. I was a silent boy, so silent that when very young I was sent to a girls' school to see if that would cure me. It did—too much; for I have been talking ever since, and I am melancholy. However, 'It's a poor heart that never rejoices,' and to look at me no one would imagine I am bowed down with grief and woe.

"Anyway I decided that the cage should be principally of wood. 'Nothing like it,' as the man said when a mad dog bit his wooden leg. Of course, the cage would not be complete without a door, and what could be better than wire, which would admit light to the little bird without excluding air. Ventilation is a grand thing, when not excessive. Then it occurred to me that a bird has eyes at the *sides* of its head, and can't look straight in front like your eye—I should say, you or I—without turning its head. My bird might wish to see something more than the sides of its cage, which would be apt to grow monotonous, if regarded attentively for, say, a couple of hours. It could certainly move its head to look out through the door, but then that might be too much trouble for the poor little thing, and, besides, some birds, especially owls, are very contemplative, and the movement might interrupt its meditations. I could not find in my heart to do this. You may say the cage is not big enough to hold an owl, if so, I would ask you whoever said it is. I am not an argumentative man, but owls are birds and this is a birdcage.

"You now understand why I put the wires on each end. My bird can look beyond its cage while sitting comfortably on the perch which every well-disposed

bird requires. I think I have now explained the why and wherefore of everything connected with the cage, which you observe is empty; however, as you would no doubt like to see my bird I shall have much pleasure in showing it you. (The professor raises the cage above his head and instantly brings it down again.) Yes, here it is all right, you can all see it hopping about. No deception this time. If any gentleman would like to assure himself let him kindly step on to the stage and examine the cage."

We avail ourselves of the invitation and carefully examine the magician's aviary, finding rather to our

The wood may be mahogany, American walnut, or some other plain stuff, *i.e.*, it should have as little figure as possible. Perhaps, all things considered, nothing can be better than sound clean bay-wood.

The sides, top and bottom, may be of ½ inch stuff, which, when worked up, will be considerably thinner. For the back a piece of ¼ inch stuff will do very well, though, as will be seen later on, it may be more easy to have this the same substance as the remainder of the box.

As it is quite immaterial how the pieces are fitted together, those who are not well up in dovetail joints

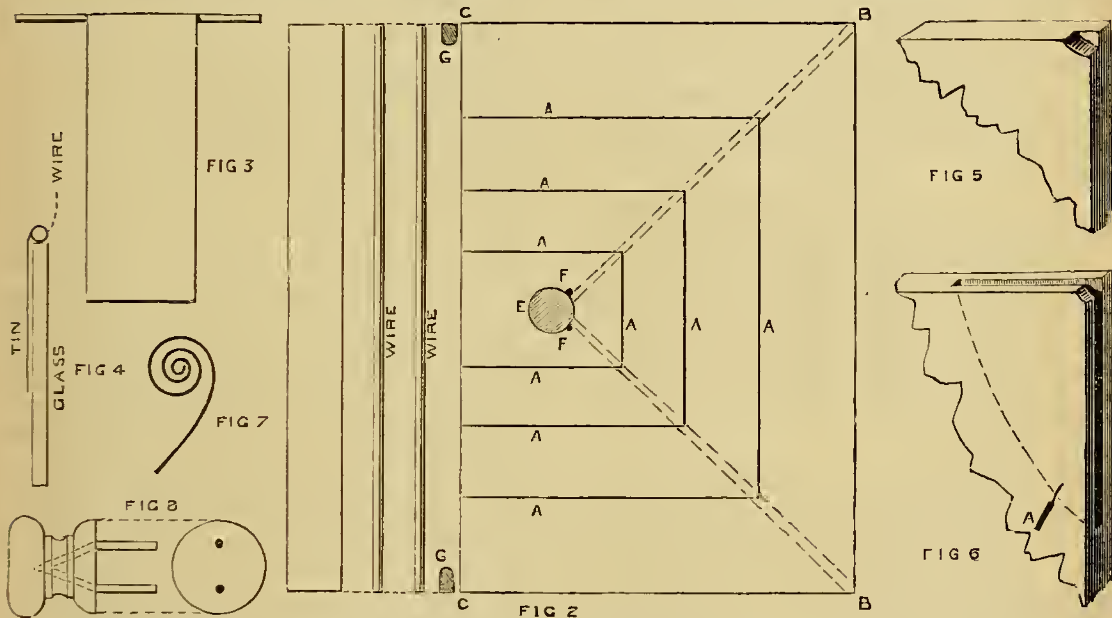


FIG. 2.—INSIDE OF LEFT HAND OF CAGE VIEWED FROM FRONT. FIG. 3.—TIN AND WIRE FOR HINGEING GLASS. FIG. 4.—SECTION SHOWING METHOD OF HINGEING GLASS. FIG. 5.—MODE OF CUTTING CORNER OF VENEER. FIG. 6.—INCISION IN VENEER TO RECEIVE SPRING. FIG. 7.—DIAGRAM SHOWING DIRECTION OF COIL OF SPRING. FIG. 8.—TURNED KNOB TO CARRY WIRES THAT SECURE GLASSES.

surprise that the measurements inside and outside correspond, and preclude the possibility of false bottom, ends, etc.; in fact, the cage looks just what it was represented to be, and as shown in Fig. 1, which is drawn without the door for the sake of clearness.

I think the drawings and following explanation will show how the illusion is managed. The size of the cage or box is not important, but one measuring about 6½ inches each way will be large enough for any small bird, such as a canary, and it may be taken as generally convenient.

As I proceed I shall draw attention to those parts whose relative proportions must be observed, so that anyone wishing to make a cage of larger dimensions need have no difficulty in doing so.

need not be deterred from making the cage. Screws or brads will do just as well as mitre dovetails, and the cage, when finished, will look equally good.

It must not, however, be inferred from this that slovenly work will suffice, for in this piece of apparatus, as in most, if not in all the apparatus used in conjuring, the successful performance of the trick greatly depends on the easy and accurate working of the various parts. Therefore, in making the cage be careful that all edges are truly squared up, and though some may think it unnecessary, it will be better to set the work out full size. Fig. 2 shows the inside of the left-hand end of the cage viewed from the front. Both ends are alike, but, of course, reversed in setting out.

The lines marked A are drawn on the wood

heavily, with an ordinary lead pencil. The distance or number of these lines is not important, but the position of the angles must be attended to carefully. To determine these draw faint lines which should afterwards be erased from the corners B, B, at an angle of 45°, with the back, or top and bottom of the wood. At these faint lines the angles of the lines A must be.

The next thing is to get the exact width from B to C. To do this it will be well to fasten the top and bottom to the ends temporarily, as measurements and distances for other parts can then be got easily. Two pieces of silvered glass (looking glass) will be required. These should not be plate, at least, the ordinary plate glass will not do, it being far too thick for the purpose, but a very thin make known, I believe, as patent plate may be used. Ordinary thin sheet glass will, however, do just as well, and is more readily obtainable, but it should be as free from flaws as possible.

The glasses being small it will not be difficult to select two suitable pieces. They must be the length of the inside of the cage from end to end, and the more smoothly the edges are cut the better, as they must work against the wooden ends easily and freely; they should fit as closely as they can be made to without being tight. In width they must be a trifle less than the length of the faint lines already mentioned, from the corners B, to the point where they bisect each other.

It will be found that the mirrors, provided they are held at angles of 45°, as shown by the dotted lines D, D, Fig. 2, reflect the horizontal parts of the lines A in such a manner as to cause them to appear perpendicular, or, in other words, the reflections of the horizontal lines appear as substitutes for the perpendicular parts A.

This is the key to the illusion, as the mirrors when in the position stated, delude the spectator into the belief that he is looking into an empty box, nothing apparently intervening between the door and the back of the cage, but the perch which, though ostensibly for the bird's accommodation, really is placed where it is in order to hide the front edges of the glasses.

Although it is necessary to fit the glasses so that the lines may be properly reflected, the final adjustment may be left till after the perch has been fixed as any trifling error can then be rectified.

The glasses may now be hinged, and some neatness will be needed with this part of the work, though, with ordinary care, no one will find any serious difficulty. Get two pieces of wire a little longer than the glass, to which they are fixed as follows: Two pieces of tin, each about half or three-quarters of an inch wide, and in length, say, two-thirds of the width of the glass, are to be soldered to the wire, the ends of the tins only being fastened; Fig. 3 will explain sufficiently what is meant. Now over the silvered side of the glass paste a strip of muslin, such as maps or children's untearable picture-books are mounted on, the size of the glass. By the way, the silvering must not be done by the old mercurial process, but by one of the newer methods generally known as the patent silvering with pure silver only. For the benefit of those who wish to try to do their own silvering, I may mention that one of the year books of photography gives several formulæ. Unfortunately I have not the book by me, so I am unable to give them here, but I hardly think it would be worth while for anyone to go to the trouble that is apparently involved. On the linen lay the tins with the wire, this being brought up close to the edge of the glass, or, rather, resting on it, as shown in section, Fig. 4. Now over the tins and muslin, using shoemakers' or other strong paste—glue would injure the silvering—as the adhesive medium, fix a slip of the thinnest obtainable veneer of the same sort of wood that the cage is made from. The veneer must cover the whole of the silvered side of the glass, and run well up on to the wire, the direction of the grain being lengthwise, not across the width of the glass.

Now, just in the corners B, B, and the corresponding corners of the other side of the cage cut, not more than half or two-thirds through, holes for the ends of the wires projecting over the glass, or, perhaps a better way to explain would be to say cut away the corners themselves, always bearing in mind that it is better not to cut right through the wood; Fig. 5 shows more clearly than words what is wanted. Now, if the ends of the wires be put in these holes and the back placed over them, it will be seen that we have two flaps showing, on one side mirror, and on the other wood—the silvered sides being those which are visible when the glasses are at an angle as already stated, and the wooden when the flaps are against the top and bottom of the cage.

The lower flap when not held up by the means by and by to be described, will, of course, of its own weight fall flat on the bottom, but the upper one requires an arrangement to cause it to move and lie flat against the top. The way to do this I will now describe, and some careful fitting adaptation will be wanted here: Cut through one or both ends of the wire, and in the division or fork made fix the inner end of the coil of a piece of watch spring. Press the wire up close to grip it tightly, if need be fastening it with a bit of solder, but be careful not to destroy the temper of the spring. Now in the top corners of the ends of the cage cut out pieces as shown in Fig. 6,

about two by three-quarter inch, measurements not important so long as there is room for the springs to play, and those I name will be ample. The width of the groove must be regulated by the width of the spring used, and whether one or two springs are necessary will depend on the strength of the spring. I believe that generally in this piece of apparatus one spring is considered sufficient, but I am rather in favour of one at each end of the wire whatever their strength, so that in the event of one snapping the other may still do the work, for as Burns wrote, the "Best laid schemes o' mice and men gang aft a-gley." To give these springs sufficient play the top of the cage as well as the back just over and behind the grooves, must be hollowed out as much as possible without coming through the wood. I have been told that unless this is done, though it is a troublesome job, the springs will certainly snap at the first opportunity. It stands to reason, of course, that the grooves must be cut and trimmed so smoothly as to leave no roughness for the springs to catch in.

Near the bottom of the grooves make incisions as at A, Fig. 6, with a small fine chisel to receive the outer ends of springs. Coil the springs up tightly, and cutting them to the proper length, insert the ends into these cuts where they may be, if necessary, fixed by some material such as coaguline. Generally they will not require anything, as the recoil of the springs keeps them in position; Fig. 7 shows the direction of the coils.

It will now be apparent to those who have followed me thus far that the springs, from their tendency to unwind, will force the upper flap, when not kept down, against the top.

The next thing will be to provide means for holding the glasses in position when the cage is shown as empty; but before doing this we will suppose that the back has been fixed in its place, and the glasses accordingly in theirs.

I don't know whether it is necessary to caution you to put the back on so that the grain of the wood runs horizontally, not perpendicularly. If placed in the latter way a keen observer might notice that the back when really seen shows the grain in a different direction from what it appeared when the cage was exhibited as empty, which would betray the secret of the trick. Hold the glasses so that the lines show at right angles as already described, and when their position is accurately ascertained bore two small holes as shown by the dots F, F, Fig. 2, through one end of the cage. These holes are for two ends of a wire to project through to keep the glasses in position, but it would never do to have these wires showing either outside or inside the cage. Therefore, to prevent them showing outside, and also as something by which they may be slightly withdrawn, a small turned knob, Fig. 8, is used. The pattern of it is, of course, immaterial.

The wires, or rather, ends of wire, for I have shown by the dotted lines in Fig. 8 the best method of fixing, must project from the knob, so as exactly to fit into the holes in the side of the cage, and should be long enough to go over the glasses and hold them in position.

In case anyone does not understand the mode of fixing the wire into the knob, let me explain. Hollow out the knob as shown by the cone-shaped lines, bend the wire accordingly, and plug up.

The perch may next be fitted, if this has not already been done, and with regard to this all that is necessary to be observed is that it hides the angle where the glasses come together, and the small wires holding them. Also glue two narrow strips of wood, G, Fig. 2, at top and bottom to hide the edges of the glasses when they are lying flat.

The cage, with exception of the wire door, which being only a wooden frame wired needs no description, and a fixed knob to correspond with the loose one to which the wire is attached on the other side, is now complete so far as special construction is concerned. It may be ornamented to any extent, and certainly unless it has been fixed together by dovetails neatly made it will be greatly improved by small mouldings fixed along each edge.

I hardly think anyone who may have made the cage according to these instructions will require further explanation, but as there may be some who do not quite see how to prepare the cage for exhibition I briefly give the leading points. The bird, or birds, are put in the triangular space formed by the back of the cage and the mirrors, which are held in position by the ends of wire in loose knobs. Seen from the front the cage appears empty. Slightly withdraw the loose knob till the wires release the mirrors, which then go flat against the top and bottom of the cage—the lower one by its own weight, the upper by the action of the spring. Nothing now conceals the bird, the actual upright lines A are seen instead of reflections, and the veneered sides of the glasses are, apparently, only the top and bottom of the cage. Of course, inside and outside measurements from back to front will be found to agree and preclude any notion of double back, false bottom, etc.

It must not be expected that this cage can be made by rule of thumb; and written instructions, no matter how full, cannot supersede the necessity for care and thought on the part of the maker to whom I can do little more than indicate the plan he should pursue. I prefer rather to hint how he can make use

of materials which he may have by him or are easily obtained, than to say he *must* employ such and such materials of given dimensions perhaps at considerable expense and loss of time.

Those who grudge giving the amount of thought rendered necessary by this method had better not attempt to make the conjuring apparatus, as they will find still greater difficulties in showing tricks than in making them, for though conjuring is a fascinating pursuit, constant attention to details, ever changing, will alone enable one to amuse his friends without exposing his *modus operandi.*

The trick explained now will be found "a host in itself," as it is very little known, and it is only sold at prices which will leave the amateur a very good margin for time and labour. I had almost forgotten to say that the cage should be polished or varnished.

My next article on conjuring will be about a simple conjuring table.

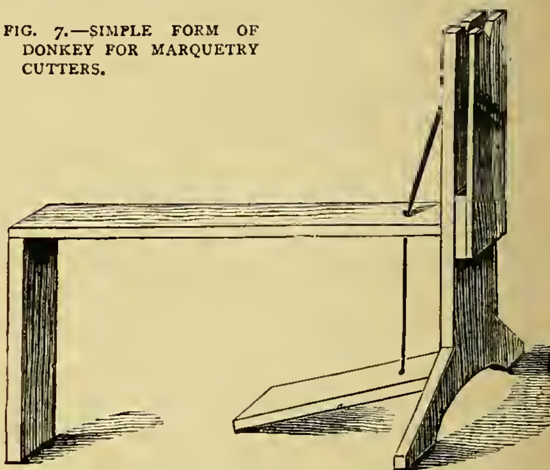
(*To be continued.*)

A DONKEY FOR MARQUETRY AND FRET CUTTERS.

By A. SINUS.

THE useful appliance I am about to describe is by no means so well known as it deserves to be. Though specially of use to marquetry and fret cutters, it will be found very handy in many ways to the amateur workman in general. It has already been referred to in the article, "Hints on Wood Mosaic" (*i.e.*, Marquetry) in Vol. IV., and some readers may possibly exclaim that the drawing there given is so clear that no further explanation can be wanted by any one for such a simple thing. If so, my excuse must be that I write for the "weak brother" amateur who, not being gifted with a mechanical mind, cannot construct anything unless he has details before him. As my donkey, however, is a thorough-bred, if I may so call it, I am not without hope that all who wish to make one will be able to discern some improvements in it. The donkey is simply a wooden vice fixed to a bench which serves as a seat, and controlled by a foot of the worker. I think reference to the accompanying illustrations will explain all that is needed. The lettering on each refers to the same part. It will be understood that the sizes given are not absolute; they are named as generally convenient, but workers must study their own requirements, and vary them accordingly if necessary. The workman ought to sit comfortably astride the narrow end of the seat or bench, A, so that his foot can easily press the lever, N, which by means of the wire M controls the jaws, G, G, placed so that he can conveniently work his saw in any piece of wood held by them. Figs. 1 and 2 show side and end elevations; Fig. 3, the plan; Figs. 4, 5, 6, the jaws on an enlarged scale. The seat A is shown 2 feet wide over all, and 3 feet long, the narrow end being about 7 inches wide. It should not be less than 1½ inch stuff, free from flaws and shakes, but if thinner be used an under framing will give the necessary solidity. Pine will answer as well as any wood for the seat and all other parts of the donkey except the jaws, though of course any will do. It is, however, only waste to use an expensive material when a cheaper will do, and our donkey, like its living namesake, is essentially for use, not for show. Were amateurs to see the rough-and-ready donkeys used by some of the best marquetry cutters, I am afraid they would not be

FIG. 7.—SIMPLE FORM OF DONKEY FOR MARQUETRY CUTTERS.



inclined to give them house room. They are veritable "mokes."

The legs, B, B, and C, may be about 18 inches long, or ordinary chair height. Those in front, B, B, are square 2½ or 3 inch. The back one, C, is a piece of 1 or 1½ inch board, 5 or 6 inches wide. Connect the front legs with stretchers, E′, E, of 2½ by 1 inch stuff, about 13 inches long, plus the thickness of the legs, into which they should be tenoned. The stretcher E′ must fit close to and serve as support for A, which can be screwed to it either from above or below. The lower one should be, say 5 or 6 inches from the ground. The legs, B, B, should also be fixed by mortise and tenon to A, and if necessary wedged, but good workmanship will render this superfluous. The back leg may be fixed to the seat with a dovetail joint. To render the whole rigid, there is a stretcher, D, connecting the back leg with the lower stretcher, E. The lower part may be fitted and fixed together permanently before proceeding to make the working parts,

as the most convenient position for them can then be better ascertained. It will be seen that the jaws are not fixed in the centre of the bench, for by placing them at the side, as shown, tbe sawyer can work with greater freedom botb with his arms and foot. The jaws, F, F, or I suppose I should say the supports of tbe jaws, G, G, sbould be of sound, tough stuff, and may be 3 inches wide, ½ inch tbick, and 12 inches long. Next get some ¼ inch or ⅜ inch stuff, say mahogany or 8 inches long, and of sufficient width when bevelled to the same angles as H to form tightly fitting slides. These slides are marked G, G, and are the jaws in which the work is held. Each should have a V-shaped notch cut in the upper ends to serve as saw guides. Of course, if the runners H have been rabbeted, the slides must be same. The slides can be adjusted to convenient heights, and are kept in position by a small screw or two, unless they fit very tightly. The

FIG. 1.—SIDE ELEVATION. Scale for Figs. 1, 2, 3, 1 inch to 1 foot.

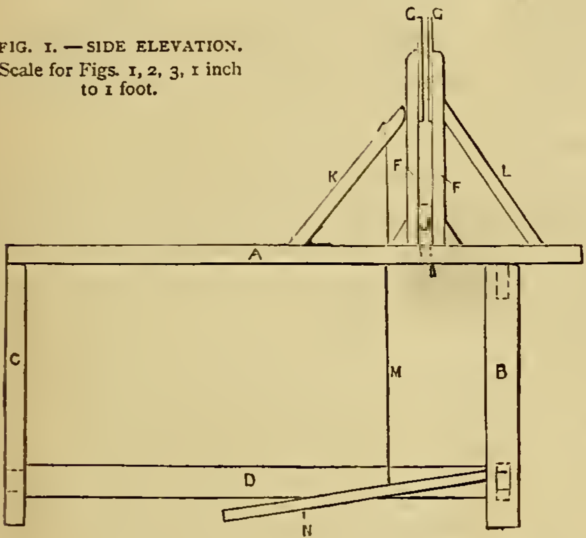
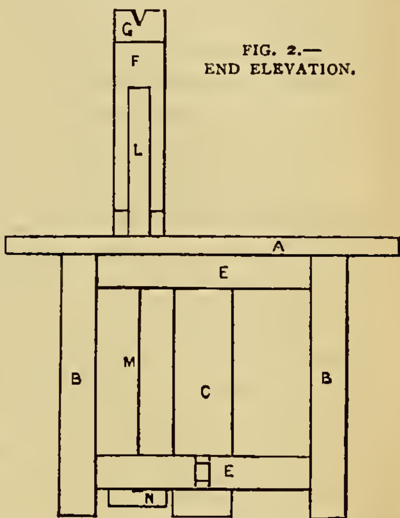


FIG. 2.—END ELEVATION.



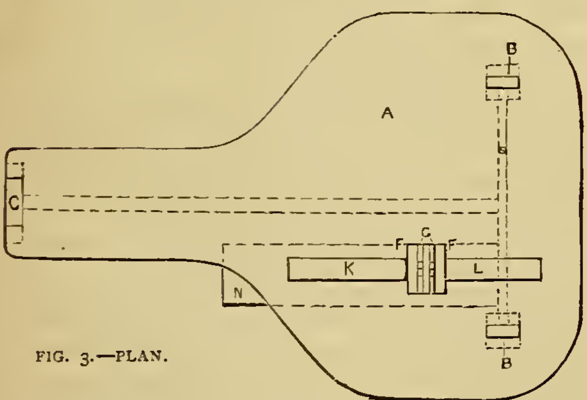


FIG. 3.—PLAN.

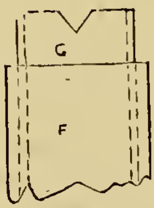


FIG. 4.—BACK OR FRONT OF JAWS.

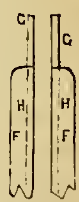


FIG. 5.—END VIEW OF JAWS.

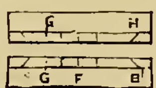


FIG. 6.—PLAN OF JAWS.

Scale of Figs. 4, 5, 6, Quarter Size, or 3 Inches to 1 Foot.

American walnut, cut four slips each 6 inches long by ½ inch wide, bevel one side of each as shown H, Fig. 6. If preferred, a rebate can be cut instead of a bevel, and it will, perhaps, be better to do whichever is cbosen before cutting the slip into 6-inch pieces. Fix them as shown in Fig. 6, taking care to keep each pair parallel. It will be well not to fix them permanently yet, *i.e.*, use no glue, only screws, which can easily be removed in case of bad fitting. Now measure off from a piece of wood of exactly the same thickness as the runners H, two pieces each 6 to advantage of having jaws that can be easily raised or lowered to suit the work in hand, will be readily perceived, but if it is considered too much trouble to make them in the way I have described, they may be made of two thin pieces of wood screwed at convenient height to F, F, or even glued only. If screws are used, take care that the points do not come right through G, G, or the work would be injured by catching against them as it is moved to the saw. At the bottom of F, F, and between them, fix the block J, which should be about ¾ inch thick, or thicker if heavy

work is going to be held. It is the same width as the jaws, F, F, and long enough to allow one to be firmly fixed on each side, especially the hinder one, which, from constant springing, is apt to work loose, unless made quite fast. It should also project below the bottom of F, F, by at least the thickness of A, thus forming a tenon for which a corresponding mortise is cut in the seat. This joint should be wedged up tightly. If needed, F F may be further secured by the triangular blocks shown on Fig. 1. L is simply a stay to prevent the front F giving when the jaws are pressed tightly together. K is a movable arm hinged at the bottom end to the seat, A. The top end, which should be rounded, rests against the hinder F. It should be 1 inch stuff, and about a couple of inches wide. Length must be regulated by height of F, and the distance of hinge. I think the illustration shows sufficiently clearly what is needed. The foot lever, N, is hinged to the lower cross stretcher E. A piece of board, sufficiently wide and long enough to rest the foot on, is all that is required. About 3 inches from the top of K, bore a hole through it, and perpendicularly below it one through the bench and one through the foot lever. Through these holes pass a piece of strong string, or preferably wire, fastening it at top and bottom. See that the long arm of lever N is high enough to allow of sufficient depression to cause the jaws to firmly hold anything put between them. The donkey may now be considered complete. The narrow part is sometimes padded, to form a more comfortable seat than the bare wood, which should have the edges neatly rounded off if a cushion be not used. The wide part of the bench forms a very convenient place to lay the various pieces of veneer as they are cut in marquetry work, and it may be further improved by having a rim nailed round it. Not the least merit of this form of donkey is that it allows of very large panels being cut in it. The cost also of the materials is a mere trifle, and the construction so simple that the roughest wood-worker can make it. For those who want something still simpler, I give an illustration (Fig. 7) of another form of donkey equally effective in action, but having no bench room, and not admitting of such large work being done on it. Amateurs, however, are not likely to attempt large marquetry panels, and the small space occupied by this form of donkey will recommend it to some. The seat is a plain plank, with a support as before at back. The front leg, widened at bottom to give stability, is fastened on to the other end of seat, and forms also the fixed jaw of vice. A small block like that in the other donkey is screwed to this, and holds movable jaw. A piece of string attached to the latter goes through holes in the fixed support and seat to the lever. Various other forms of donkeys are made, but having specified two, which I consider respectively the best and the simplest, I will not presume to hint by further instructions that you, dear reader, are a third. If, however, I have not been sufficiently explicit for you, by referring to my *nom de plume* you will see you may be reasonably assured of fraternal sympathy, and that any doubtful points will be explained in "Amateurs in Council."

THE REFLECTING TELESCOPE:

ITS CONSTRUCTION AND MANUFACTURE.

By EDWARD A. FRANCIS.

IX.—POLISHING THE SPECULUM (*continued*)—TESTING.

THIS chapter, the ninth, is certainly the most difficult to write, and will probably require more study for its complete understanding than any other of the series, yet is it the most valuable of them all. It will be useless to attempt to master it until what has preceded it has been mastered. Bearing in mind, however, the purpose for which these papers are printed, the writer has confined himself rather to a simple description of effects that may be observed in speculum testing than to any attempt to account theoretically for such effects; and the slight theoretical reference indispensable has been couched in elementary terms, and has been elucidated by self-explanatory diagrams.

It will be assumed in this, as in the last chapter, that the process of testing of M. Foucault there introduced, is being practically investigated in the testing-room. It was there discovered how one might detect the centre of curvature of any concave spherical mirror, by the regular and even fading away of the light of the illuminated surface, under the action of the screen. That the experimenter should learn to detect accurately when the screen is at the centre of curvature, is of the utmost importance; it is not easy to do so, when any figure other than a spherical one has been communicated to the speculum. However irregularly the light and shadow may be distributed over the illuminated disc, if the screen be at the general focus, the mean centre of curvature—the shading will appear simultaneously (albeit in different degrees) on the whole surface. It will not advance either way in a solid wall as in the illustrations of the last chapter.

The term "general focus" is used because it must be completely understood that in any other curve than a spherical one, the rays reflected from the central portion of the speculum, and the rays reflected from

the portion of the speculum close to the circumference, have each a distinct focus, as has any zone between the centre of the speculum and its edge. The "general focus," or more truly the mean centre of curvature, is assumed to be midway between the focus of the centre and the focus of the edge of the speculum, for if the screen be placed at that point the contour of the concave will be accurately seen.

By this time it should be apparent, that the quality of any curve is distinguished by the arrangement of light and shade upon the glass surface, when the screen is passed over before the eye at the centre of curvature. Before we proceed to treat of the possible curves, it may be as well to ascertain what may be read from the appearance of the shading on a speculum, without considering for the moment, the cause of such shading. In the long shadows of these July afternoons an analogy may be seen. Hill, bush, anything which rises above the common level, casts a darkness upon the greensward away from the sun, and were we raised high in the air, although it would not be actually evident that the hill or the bush rose from the earth, we might demonstrate from the patch of shadow beside each, that such indeed was the case. In like manner, when we study the surface of the moon, we tell by the shadow alone where some vast range of high land is reared up, or where the plain sinks far below the general level.

Looking at the speculum from our position beside the lamp, we must imagine the light to stream ob liquely from the right to the left hand, an opposite direction to that from which the screen advances. Wherever a deep shadow is seen, there we may know there is an elevation to cause such a shadow; wherever is seen a patch of especial brightness, there we may know that the glass rises again to catch the light.

Let us, remembering this, read Figs. 51, 55, and 59, each of which is a sketch of a mirror of some peculiar curve under test. The first (Fig. 51) exhibits no irregularity of light and shade, it is even and unbroken, and the solid which the speculum presents is that of a perfectly plane surface, as shown in section in Fig. 53.

The second sketch, Fig. 55, departs considerably from uniformity of shading; the curve is not spherical. Reading from the right hand to the left, the direction opposite to that indicated by the arrow, we may draw a section of the solid. A patch of darkness, to cause which there must be a depression, down hill as it were; let this be drawn. The darkness passes away gently into light; the side of a central hill, the other side of which is plunged into shade: mark down a central hill. Beyond the second darkness, light again, the curve rises: so draw it, and we get the apparent solid, shown in section in Fig. 57.

The third illustration, Fig. 59, which, be it noted, is the exact reverse of Fig. 55, shall be left for the reader that he may test his newly-acquired knowledge, it will be found to yield the section shown in Fig. 61.

It matters not how irregularly distributed the shading may be, even if the resulting section be but a sinuous line, the exact curve can be read off, remembering always that the screen *must* be placed at the mean centre of curvature. The more intense the contrast of light and shade, the greater will be the departure of the actual curve from the sphere.

It will be noticed that the spheric speculum (Fig. 51) appears in solid (Fig. 53) as a level surface. The other solids, Figs. 57 and 61, merely represent their relative curves as compared with (or projected on) a sphere of similar radius. The necessary treatment to be adopted to bring either of those mirrors to that spherical curve is plainly indicated. In Fig. 57 if the centre hill of the speculum were worked down and the edges also lowered, the section would be that of a level surface, and the mirror would be of a spheric curve; the same end would be obtained with Fig. 61 by polishing down the glass, midway between the centre and the edge; of this more hereafter.

In the other illustrations where the arrangement of the reflected light-rays at the centre of curvature is shown, the lines merely indicate the direction in which a pencil of light would be reflected. When a line is shown to be obstructed by the screen, it must be considered that the portion of the speculum which the line indicates would appear darkened to the eye; and if the screen is shown as cutting the junction point of two lines, the parts of the speculum surface from which the two lines spring would be simultaneously and equally shaded.

Should the reader experience any difficulty in comprehending the meaning of Figs, 50, 54, and 58, he is recommended to construct them on paper for himself in the order which the various parts are mentioned in the descriptive letterpress, for it is essentia if he would work intelligently, that he should comprehend them.

There are five curves, any one of which the glass concave may assume as the result of the polishing. The whole art of speculum-making lies in the capacity, firstly, to detect which of the curves has been obtained, and, secondly, to so dispose the length of stroke and method of working, that may, with that curve certainty, be changed to any one of the other curves. The five curves referred to are: (*a*) the oblate spheroid, (*b*) the spheric, (*c*) the elliptic, (*d*) the parabolic, (*e*) the hyperbolic. These may be sub-

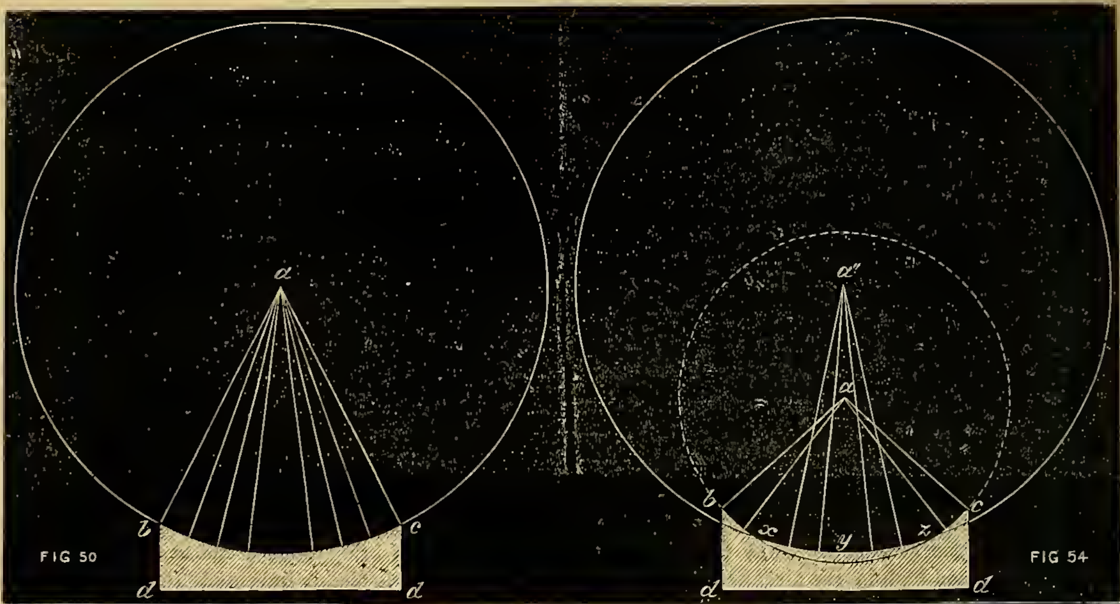
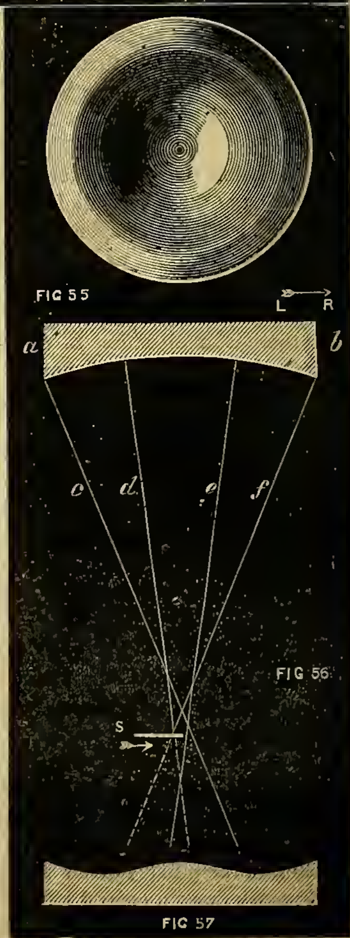


FIG. 50.—DIAGRAM SHOWING CAUSE OF ACTION OF SPHERIC CONCAVE MIRROR AT CENTRE OF CURVATURE. FIG. 51.—APPEARANCE OF SPHERICAL SPECULUM UNDER TEST. N.B.—The Arrow in this and other Diagrams indicates direction in which Screen is moved from left to right hand. FIG. 52.—SHOWING ACTION OF TESTING SCREEN ON RAYS REFLECTED FROM SPECULUM IN TESTING TO PRODUCE APPEARANCE INDICATED IN FIG. 51. FIG. 53.—APPEARANCE OF SPHERIC SPECULUM IN SOLID, OR IN ELEVATION. FIG. 54.—DIAGRAM SHOWING CAUSE OF ACTION OF OBLATE SPHEROIDAL CONCAVE MIRROR AT CENTRE OF CURVATURE. FIG. 55.—APPEARANCE OF OBLATE SPHEROIDAL SPECULUM UNDER TEST. FIG. 56.—SHOWING ACTION OF TESTING SCREEN ON RAYS REFLECTED FROM SPECULUM TO PRODUCE APPEARANCE INDICATED IN FIG. 55. FIG. 57.—APPEARANCE OF OBLATE SPHEROIDAL SPECULUM IN SOLID, REPRESENTING RELATIVE CURVE IN RELATION TO SPHERE OF SIMILAR RADIUS.



divided, so far as testing is concerned into three divisions :—

(*a.*) *The Oblate Spheroid.*

(*b.*) *The Spheric.*

(*c.*) *The Elliptic, Parabolic, and Hyperbolic.*

For the oblate spheriod has an arrangement of light and shade peculiar to itself, as has also the spheric curve; but the shades of the elliptic, parabolic, and hyperbolic curves present the same general character, and glide, like the different grades of intensity in an exquisitely shaded drawing, almost imperceptibly one into the other. The difference between any of the curves is absolutely inappreciable, so far as measurement of thickness of the glass is concerned. Consequently, with the exception of the drawings indicating the appearance of the several curves under the test, the effects illustrated by the diagrams in this paper are greatly exaggerated, and the diameter and focal length of the speculum are, as will be immediately evident, entirely out of proportion to each other. Were it not for this it would be impossible to illustrate the microscopic irregularities in the paths of the reflected light rays.

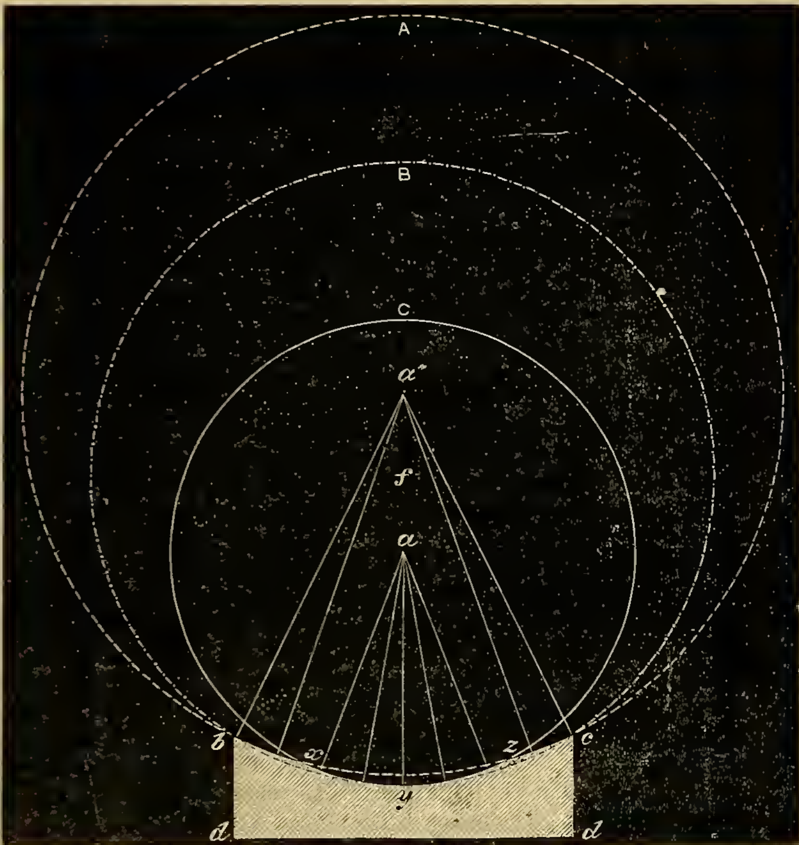
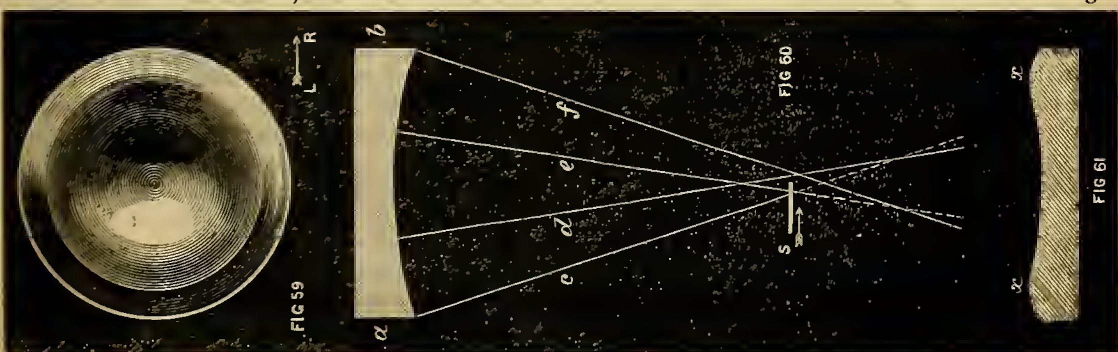


FIG. 58.—DIAGRAM SHOWING CAUSE OF ACTION OF MIRROR OF ELLIPTIC, PARABOLIC, OR HYPERBOLIC SECTION AT CENTRE OF CURVATURE. FIG. 59.—APPEARANCE OF HYPERBOLIC SPECULUM UNDER TEST. FIG. 60.—SHOWING ACTION OF TESTING SCREEN ON RAYS REFLECTED FROM SPECULUM TO PRODUCE APPEARANCE INDICATED IN FIG. 59. FIG. 61.—APPEARANCE OF HYPERBOLIC SPECULUM IN SOLID, REPRESENTING RELATIVE CURVE IN RELATION TO SPHERE OF SIMILAR RADIUS.

We will first compare the curves, considering their action at the centre of curvature. The spherical mirror may be taken as a standard—a kind of zero, ranged on either side of which lie the other curves. The rays of light reflected from it are of equal length (see Fig. 52), and meet, consequently, at one and the same point.

Above zero, as it were, is the oblate spheroid, the rays reflected from which *increase in length*



from the edge to the centre (see Fig. 56), so that those from two or three inches of the centre of a speculum would meet and form an image more distant from the glass surface than would those from the edge.

Below zero may be grouped the third division—*the elliptic, parabolic, and hyperbolic curves* (see Fig. 60), where the rays *decrease* in length *from the edge to the centre;* and where the central part of the speculum would reflect an image nearer to the surface of the mirror than would the outer rays.

Now to consider each curve separately and exhaustively:—

The Sphere: (Figs. 50, 51, 52, and 53).—The peculiar property of this curve should be by this time well known to the reader. If a circular knife were rotated against a block of any soft substance, a concavity, circular in section, similar to the speculum $b\ d$, $c\ d$, Fig. 50, would be dug out. Such a concavity, if reflective, would form a spheric speculum. In Fig. 50, a is the centre of curvature, to which the light (from the testing-lamp) is reflected directly and perfectly, forming there *one* image of the source of light. This is the curve which the optician should strive to obtain, for the difference between it and the required parabolic curve, is so excessively minute, that the most difficult part of the work is done when the sphere is attained.

Under test, it appears to the eye as in Fig. 51, a regularly shaded, apparently flat surface. The reason of this will be evident on an inspection of Fig. 52, where it may be seen that the screen S cuts off the light from every part of the speculum $a\ b$, evenly, allowing none to escape past into the eye. The apparent solid, read as previously indicated, appears in Fig. 53.

The Oblate Spheroid: (Figs. 54, 55, 56, and 57).—In Fig. 54 let that part of the dotted circle between the lines $b\ d$ and $c\ d$ be a section of a spherical mirror, then a will be its centre of curvature. Light rays proceeding from a to any part of the dotted mirror section will be exactly reflected to a again. But if, instead of receiving such a spherical curve, the speculum has been polished to a section represented by the shaded portion of the diagram, and bounded by the part dotted, part solid curve, b, x, y, z, c, a line formed partly of a curve of the radius a, y, and partly of a curve of the radius a'', y, then the resulting speculum will be part of an oblate spheroid.

For the words *oblate spheroid* literally mean, *flattened sphere*, and very evidently, the solid line $x\ y\ z$ appears as if the dotted curve below had been pressed up or flattened toward its centre, as the earth is flattened at the poles. So that the difference in the length of the reflected rays is at once accounted for. The centre of curvature of the outer portions $b\ x$, $z\ c$, would be discovered at a, and there an image would be formed; but the centre of curvature of the other portion x, y, z, would be discovered farther away at a'', because the arc $x\ y\ z$ is part of the circle having its centre at a''. The procedure necessary to reduce such a curve to a sphere is indicated in the figure. Either the edges $b\ x$, $z\ c$, must be reduced to the solid line so that the whole surface will have its centre of curvature at a, or the centre between x and z must be polished down to the dotted line, so that the common centre of curvature shall be at a''. In the first case the mean focus will be increased; in the latter case decreased. An intermediate course may be adopted, that of polishing away part of the edge and part of the centre, when the centre of curvature would be represented in the diagram by a point midway between a and a''.

It may be interesting to compare this figure with the section of the solid at Fig. 57, so as to see how theory and practice entirely agree, for the apparent solid (Fig. 57) would require treatment identical with that just enunciated, to make the section that of a level surface, and the mirror spherical.

The appearance of an oblate spheroid at the centre of curvature is sketched at Fig. 55; the cause of the shading will be evident from an examination of Fig. 56. The rays $c\ f$ are reflected from the edge of the speculum, $d\ e$ from the more central portions. The screen S is advanced in the direction of the arrow from left to right, first encountering $d\ f$ at the point of junction. Consequently, the parts of the speculum to which those lines relate, will appear to be darkened. The rays represented by the lines $c\ e$ escape past the screen, and enter the eye; consequently, the parts of the mirror indicated by those lines will still be illuminated.

The section of the apparent solid is shown in Fig. 57, the procedure necessary to transform such a curve into a spherical one has already been indicated.

The Hyperbolic Curve.—This, the most extreme of the three other curves which have been classed together, will best serve to indicate the peculiarities common to all.

Fig. 58 is a diagram rather more complicated than either of the others. The shaded solid $b\ d$, $c\ d$, is a section of a speculum, the central part $x\ y\ z$ of which is formed of the curve C having its centre of curvature at a, to which the light rays are reflected, but the outer parts $b\ x$ and $z\ c$ have polished part of the greater curve A having its centre at a'', and consequently, rays reflected from those outer parts, form an image at a greater distance from the speculum, than do the inner rays. The general curve of the mirror will be that indicated by the line $b\ x\ y\ z\ c$, in which it will be

noticed that x and z are two hills above the general level, and this will be made more evident, if a third circle B which shall cut the centre and edge of the speculum, and which shall have its centre at f, be drawn. This last circle will represent the sphere to which the speculum would be polished by reducing the hills x and z, that is, by polishing away especially a zone between the centre and the edge of the speculum.

The reason why the outer rays are longer than the inner, in a mirror of this curve, is so evident from the figure, that no further explanation will be required.

The appearance of a hyperbolic mirror at the centre of curvature is shown in Fig. 59, for the reason illustrated in Fig. 60. The screen S, intercepting the rays $c\ e$, but permitting $d\ f$ to pass directly to the eye. The apparent solid (similar to the curve $b\ x$, $y\ z\ e$ in Fig. 58) is drawn in section in Fig. 61. To reduce the speculum to a sphere, the zone $x\ x$ will require to be polished down.

We will consider theory no farther in this paper, but will conclude with a few general remarks. Most probably the amateur will be somewhat astonished when he first begins to test, at the manner in which the atmospheric agitation is projected on the illuminated speculum surface. The air is seen to be in a constant state of motion, and any variation in temperature, the lighting of a gas jet near to the glass, or the opening of a window, will cause most tantalising effects. Therefore was it that he was recommended to work late at night, and in the lowest part of the house. The room should be without a fire, there is then less likelihood of air currents becoming obnoxious. The delicacy of the test may be proved in a simple way, and at the same time a useful lesson may be read. Having placed the speculum in position, and having everything prepared for testing, place one finger on the glass surface for a minute, and then retire to the testing table and witness the result—a tiny hillock. Moral : Do not handle the surface of the speculum when working, for such a hillock takes a considerable time to cool down, and if the polishing were proceeded with before it had cooled down, it would be polished away, and then when the speculum came to its regular temperature, a hollow would be the result.

One more sentence.—In a previous paper, Mr. Mudge's habit of polishing in spring and autumn was quoted. Here is a warrant for working in another season : "In the long days of the summer months," wrote William Herschel's sister, "many ten and seven foot mirrors were finished ; there was nothing but grinding and polishing to be seen." Thus we have the best authority for polishing during at least three-fourths of the year, if not for all the year round.

(*To be continued.*)

GLASS PAINTING AND DECORATIVE GLAZING.

By L. L. STOKES.

VI.—PLAIN PATTERN GLAZING (*continued*)—REPEATING PATTERNS—CONCLUSION.

IN this, our final chapter on ornamental glass work, we have to revert to the subject of plain pattern glazing, of which the present Number contains some additional examples.

A more intricate design than those last given, but one which, if well carried out, would have an effect scarcely less rich than that of stained work, is to be seen in Fig. 32. It is intended for three tints of glass. As the ornament of the central part repeats, it may be applied to windows of longer or shorter proportions. Fig. 33 is a running border, which will admit of working out in various schemes of colour.

As regards arrangements of colour in plain pattern glazing generally, it may be observed that it is not well to indulge largely in such strong and decided hues as can be freely used in stained glass work ; for, without the softening and combining influence of the painting employed in the latter, there is danger of producing a vulgar and glaring result. It is better taste to keep the colours moderately low in tone, and not to make too liberal a use of the primaries. As has already been said in connection with some of our illustrations, much may be done by a judicious varying of different tints of the same colour, and by making harmony rather than contrast the leading motive in the composition. Cathedral glass, with its waved surface and low neutral tints, may be freely used to good purpose. In this, too, the various shades of tone—the absolutely white, and those inclining towards yellow and green—afford means of gaining variety without danger of anything like garishness.

Somewhat akin to this, and capable of adaptation to similar use is another material which in country districts may often be had for, so to speak, an old song. This is "Cottage Glass," a glass of uneven surface, and generally of a dull, greenish hue, with which cottage windows were formerly glazed—for in the old days of high glass duties it was exempted from taxation as being specially a manufacture for the poor. At the present day it is constantly being removed, to make way for clear, cheap modern glass. Country glaziers throw it away, and may be induced to collect and dispose of it for a mere trifle. It is only to be had in small pieces, but for plain pattern work this matters little.

Though neglected at present, it is quite possible that a time may come when this material may be in

high request. Many things regarded as "unconsidered trifles" but a few years since, are now eagerly sought after and highly prized by the collector. As, for instance, the old Verona "oyster glass;" those who know its value as a *specialité* when they now meet with a window filled with it in some humble quarter of the old Italian city, are only too glad to secure it by supplying its place with the brightest and clearest of modern panes; thus following the example of the magician in the story, who gave new lamps for old. Some such future may perhaps be in store for our "Cottage Glass."

This glass has a considerable variety in its tints, as may be seen in the windows of unrestored country churches, which are commonly rich in it. In these windows we find a promiscuous collection of quarries of many shades and hues as they have been added by the menders of various periods. One such window occurs to the memory of the writer, in which is (or was) a wonderful jumble of lovely dim greens and yellows, the beauty of which has occasionally, in times past, led away his thoughts in the direction of sacrilege when they ought to have been fixed upon the sermon. Indeed, the "restoration" of an old church offers opportunities to those interested in glass which should not be neglected. Besides the kind in question, fragments of old grisaille and stained work are at such times to be picked up for next to nothing, but which can be turned to good account by the plain pattern glazier.

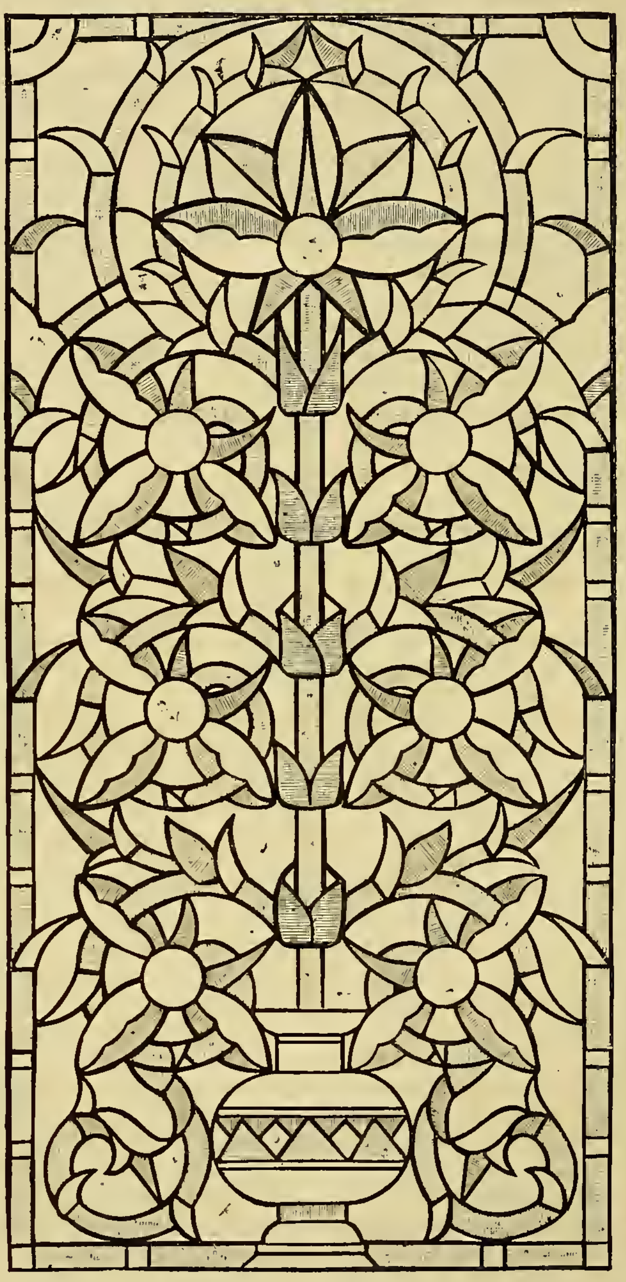


FIG. 32.—WINDOW IN PLAIN PATTERN GLAZING—THREE TINTS OF GLASS—NO GLAZING.

Whilst on the subject of such small economies, another may be mentioned of which the amateur may be glad to avail himself.

A friend of the writer has zealously collected from all his acquaintances the feet of broken wine-glasses, for use as circular pieces in his plain pattern work, for which purpose they are admirably adapted when obscurity is wanted. Such pieces are indeed made and sold for this purpose, but at rather a high price.

Figs. 34, 35 and 36 illustrate the manner in which the hexagon and its parts may be combined and utilized in the production of patterns for our purpose. It will be found in practice that they can be varied almost to infinity. The "box pattern" in Fig. 35 may be used in combination with the star.

The last illustration, Fig. 37, is intended to show the manner in which odd scraps of coloured glass may be made of service as "random work." In carrying out the design for a large window it would be found well to introduce leads along the dotted lines in the fleur-de-lis.

From what has been said with regard to Glass Painting and Decorative Glazing, the intending

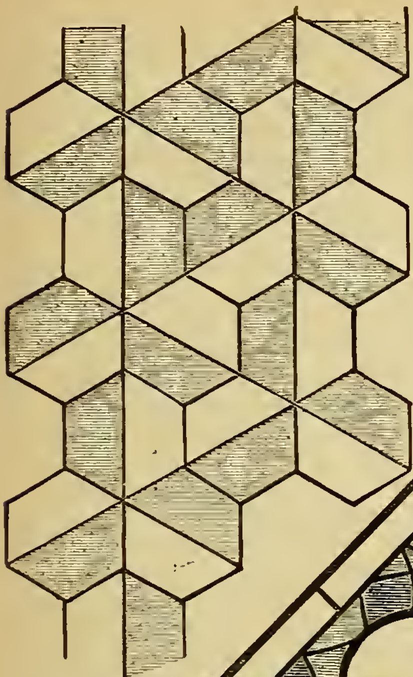


FIG. 36.—COMBINATION OF THE HEXAGON.

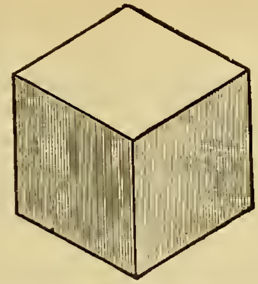


FIG. 35.—BOX PATTERN IN THREE TINTS.

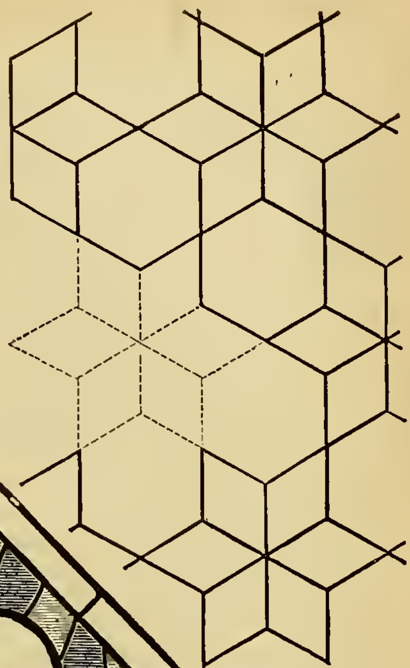


FIG. 34.—HEXAGON AND STAR.

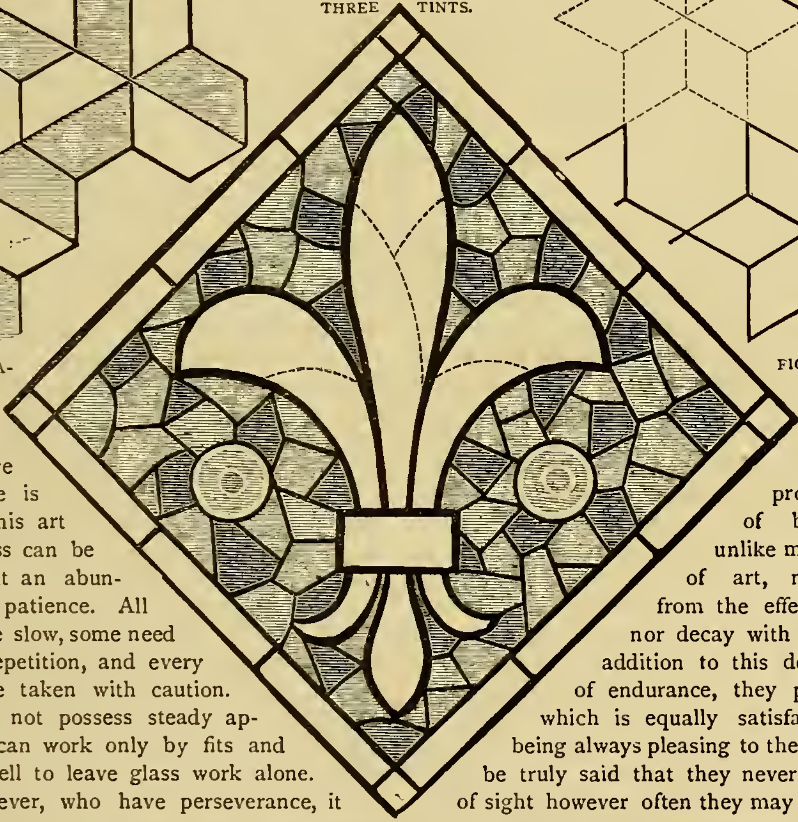


FIG. 37.—RANDOM WORK.

worker will, it is hoped, have seen that there is no branch of this art in which success can be attained without an abundant supply of patience. All its processes are slow, some need repetition on repetition, and every step has to be taken with caution. Those who do not possess steady application, who can work only by fits and starts, will do well to leave glass work alone. To those, however, who have perseverance, it offers a tempting means of producing things of beauty, which, unlike most other works of art, neither change from the effects of climate nor decay with time. And, in addition to this desirable quality of endurance, they possess another which is equally satisfactory—that of being always pleasing to the eye, for it may be truly said that they never tire the sense of sight however often they may meet the view.

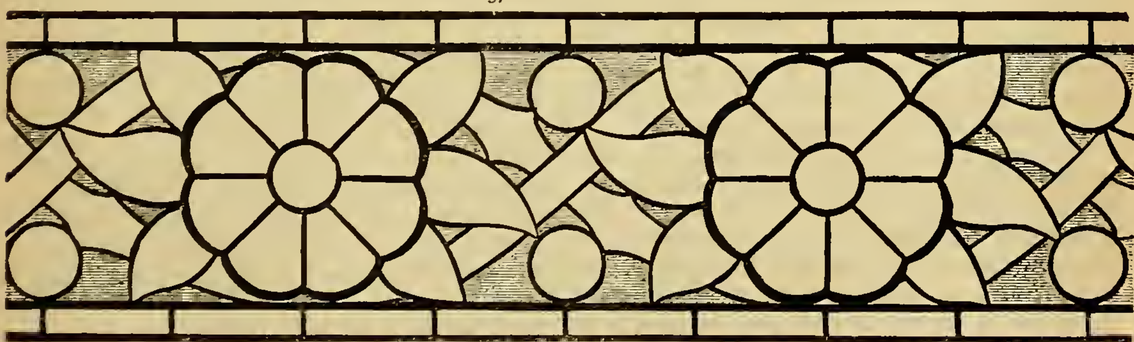


FIG. 33.—RUNNING BORDER IN PLAIN PATTERN GLAZING.

ENAMELS: HOW TO PREPARE THEM.

By JOSEPH HARRIS.

I.—LENS AND CAMERA—PREPARATION OF PLATES—BATH—IMMERSION OF PLATE—EXPOSURE—SELECTION OF NEGATIVES.

A REFERENCE to that inexhaustible mine of information—tradition—and no matter what the subject, a diligent search is always certain of reward. For instance, the immortal Shakespeare is duly credited with having predicted all modern discoveries and inventions, from the telegraph and the danger of overhead wires, to the extravagance of a London School Board. A certain student was once bantered by the ever-present sceptic to name the passage wherein the great bard foretold the treadmill. The rejoinder was immediate, in the words, "Down, down, thou climbing sorrow!"

And with as much approach to veracity as is contained in the foregoing paragraph, does the professional photographer but too often predict the insuperable obstacles in the way of successful production of enamels by the agency of photography. It would be nearer the truth to assert that the process in question is one of the greatest beauty, and, as a consequence, one of extreme delicacy. This by no means infers difficulty, but simply the exercise of care to conduct the operations to a successful issue. In the following instructions certain materials are distinctly specified, and it may be as well to state at the outset that it will not be sufficient to substitute other solutions or other times of immersion therein, on the plea that the one is to hand and the other has to be procured, or that a minute or so more or less cannot affect the result.

The lens to be employed should be a *short* focus portrait combination; the "stereoscopic" of Dallmeyer or Ross is the best, and the objective should not be stopped down too much. The most useful form of camera is the C.D.V., with repeating back, enabling two films to be taken for choice; a minute speck of dust will militate against that beauty of image which is an absolute essential in a perfect film. Take every precaution with the dark room—not a bottle in the place but those which are to be used from. Wash down the shelves and the floor the day before commencing operations, and dust out the dark slide.

Procure half-a-dozen *patent plate* glasses the size the slide will take, and do not substitute flatted crown. The surface of the former has the highest polish, and is free from irregularity; the latter often contains imperfections, which will cause the film to hang, and thereby to tear on detaching from the glass. Clean the plates by means of a pledget of cotton wool immersed in a weak solution of nitric acid and water; rub the surface with a circular motion, taking care to clean the edges well; the centres will look after themselves. Rinse under the tap, dry in a linen diaper cloth which has been cleansed by washing in common soda and water (*no soap*), and polish with an old silk handkerchief or soft cloth, which, like the diaper, has been washed without the agency of soap. Always dry and polish the plates by rubbing with a circular motion, *never* across or up and down the glass. When finished put the glasses in a cupboard or box away from the dust, and when about to try a film, repolish the glass *outside the dark room* with a soft chamois leather (remember the circular motion); gently breathe on the surface, and when the breath will leave quickly and uniformly, showing neither smear nor mark, the plate may be relied on as chemically clean. Hold it between the finger and thumb, and with one eye look along the surface, and remove *every speck* of dust by the agency of a two-inch flat camel-hair brush, which must be kept strictly for that purpose, and for no other use whatever. When there is not a trace of dust on the plate, carry it face downwards to the dark room, and coat with Thomas' iodized collodion for iron development. It is very essential that this collodion has been iodized at least *three* months; six months will be an improvement. Iodize a pint at a time, and carefully decant about four ounces in a clean stoppered bottle to work from. Always avoid disturbing any sediment at the bottom of the stock bottle, and as soon as any settlement appear in the smaller vessel, filter it at once. It is preferable to work alternately from *two* smaller bottles of collodion when coating plates, as in returning the surplus fluid there is risk of disturbing the bottom of the solution. It will sometimes happen that in coating the plate, a particle of dust in the air will settle on the wet surface, cast the glass aside at once to be re-cleaned, and take a fresh one; the speck of dust, almost invisible to the eye, will present a black spot in the finished enamel, to the utter ruin of the picture as a perfect specimen. The collodion should be allowed to "set" rather longer than in the ordinary "wet" process, and the plate is ready for immersion in the nitrate of silver bath, which *must be kept for enamel work only*. On no account may a different sample of collodion be used in this bath while employed in the production of films. The bath is made as follows:—Triple crystallized nitrate of silver, 1 oz.; distilled water, 16 oz. (both from Thomas, *Pall Mall*). Dissolve the silver in the water, filter, and render very faintly acid with dilute nitric acid. Coat a plate with collodion, and allow to remain in its silver solution about 12 hours; this will iodize the bath. It may appear strange that stress should be laid on the purchase of *distilled* water; but, nevertheless, it is a common experience that the

neighbouring chemist is often resorted to, forgetful of the fact that water which will suffice for ordinary commercial requirements is totally unsuited to those operations where absolute purity is a *sine qua non.* The bath above mentioned may be relied upon as free from every trace of that organic impurity which, if present in ever so small an amount, would be amply sufficient to ruin the enamel.

The plate being immersed without stoppage by one downward motion, should be gently moved up and down till all appearance of greasiness disappear ; it should then remain in the silver solution for three minutes in a dark room, temperature of not less than 50 degrees. The dipper should now be drawn up to the top of the bath while the plate drains off its excess of silver ; it is then removed and again drained on a clean pad of white blotting paper, and the back wiped with a wad of the same material; the lower corners of the dark slide are covered with a small piece of white blotting, and the plate is transferred to the slide ready for exposure.

In one of the upper rooms of the house darken with brown paper the whole of the window except a portion large enough to admit placing the negative against the glass ; if this window overlook opposite houses or the verdant landscape in the distance, cover the pane left open with papier mineral—the exposure in the camera will be slightly prolonged, but this is immaterial. Have the camera opposite the negative, and arrange the size, remembering to give the second half of the plate from three to five seconds longer time than its first half, so equalizing the two. It is impossible to give a definite time for the exposure ; what is required is an image which when developed shall present much the appearance of a good lantern transparency ; the half tones must be just visible, the high lights clear glass, the shadows not too intense.

Never select negatives with white backgrounds, unless a vignette be desired; the white, or very light background gives a poverty of appearance to the finished enamel, which is in striking contrast to the richness obtained by the selection of dark grounds.

(*To be continued.*)

PRACTICAL SCENE-PAINTING FOR AMATEURS.

By HENRY L. BENWELL.

XV.—TYPICAL SCENES (*continued*)—STREET SCENES.

MR. HARRY LANCASTER, an old authority on this subject, speaks as follows of street scenes : "With many artists these scenes are special favourites, and when they consist of picturesque old houses or grandly decorative architectural features, or rustic towns and villages full of quaint feeling, and intermingled with trees and gardens, I can fully appreciate their tastes. These afford notable opportunities for display of light and shade, form and colour; but it is otherwise when rows of brick boxes with oblong holes divided at right angles by light window sashes are the things required. . . . . Street scenes can be made very effective, and particularly so by using set-pieces leading up to the scene; and in scenes of this kind you should never have the point of sight above the natural height of the spectator on the stage. Bird's-eye views seldom look well in these scenes. Where you are supposed to be looking up a street, it is perhaps most effective to keep one side entirely in shadow. In painting the windows, lay them in first with raw sienna, then add a glaze of vandyke brown, by glazing which over again with indigo, and leaving a little light in the corners of the panes, and by repeating this treatment two or three times judiciously, it will appear in front as if you could actually see through the glass into the rooms. The old-fashioned and far-less effective way, was to paint them quite black, when they looked like unglazed holes. For a good stone colour mix a pot of rose-pink and white, another of Dutch pink and white, and a third of indigo and white ; rub all these indiscriminately together, and while all the colours are wet go over the whole with the stone colour. By this plan you get a natural mottled appearance very suggestive of a surface of stone. The stone colour may be made with white, yellow ochre, and Dutch pink ; many lay it in all over, one bright clean colour like the comic scene of a pantomime ; but as a rule, houses do not always look clean. When painting such scenes, always endeavour to make the part of the roadway touching the stage as near the colour of the boards as possible ; some have no regard for this, and the scene and stage are consequently distinctly separated instead of blending as parts of one whole. In 'set' street scenes you can introduce many realistic effects, such as balconies built out from the houses, 'set' portico piece over doors, with 'set' steps made by the carpenter leading to the doors, etc., all of which add to the effect and apparent reality of the scene. . . . . Every scene should be correctly drawn according to the rules of perspective ; just conceptions should also be formed of light and shade, the foundation of which is the obvious principle, that the light always proceeds from one point. It is of primary importance when dealing with street scenes that the buildings should be in accordance with the time, style of architecture and country in which the scene is laid. If Grecian or Roman buildings are introduced, care should be taken to learn the character of these styles at the

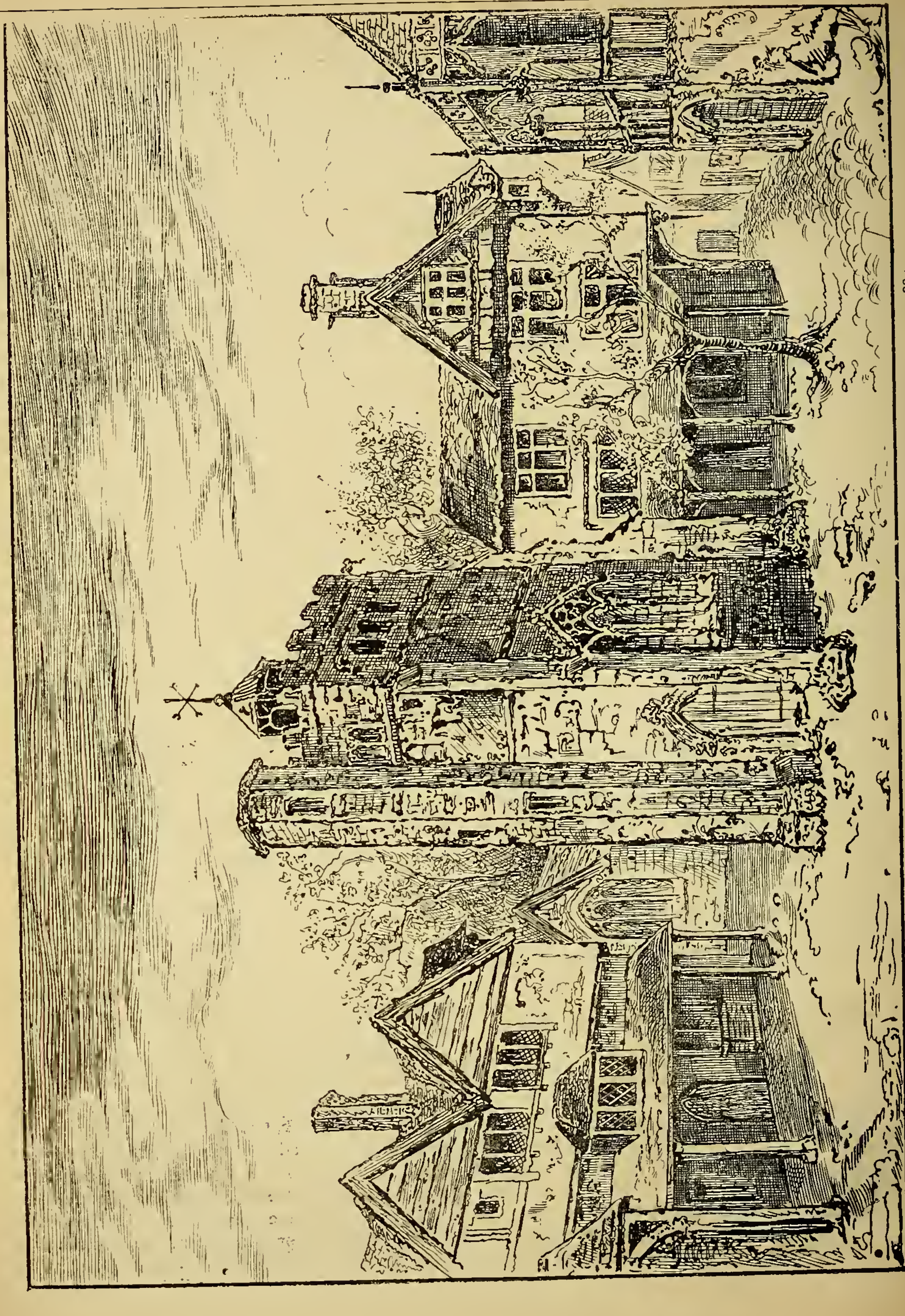


FIG. 79.—A MARKET PLACE. SKETCHED FROM "OLD LONDON," INTERNATIONAL EXHIBITION, 1885.

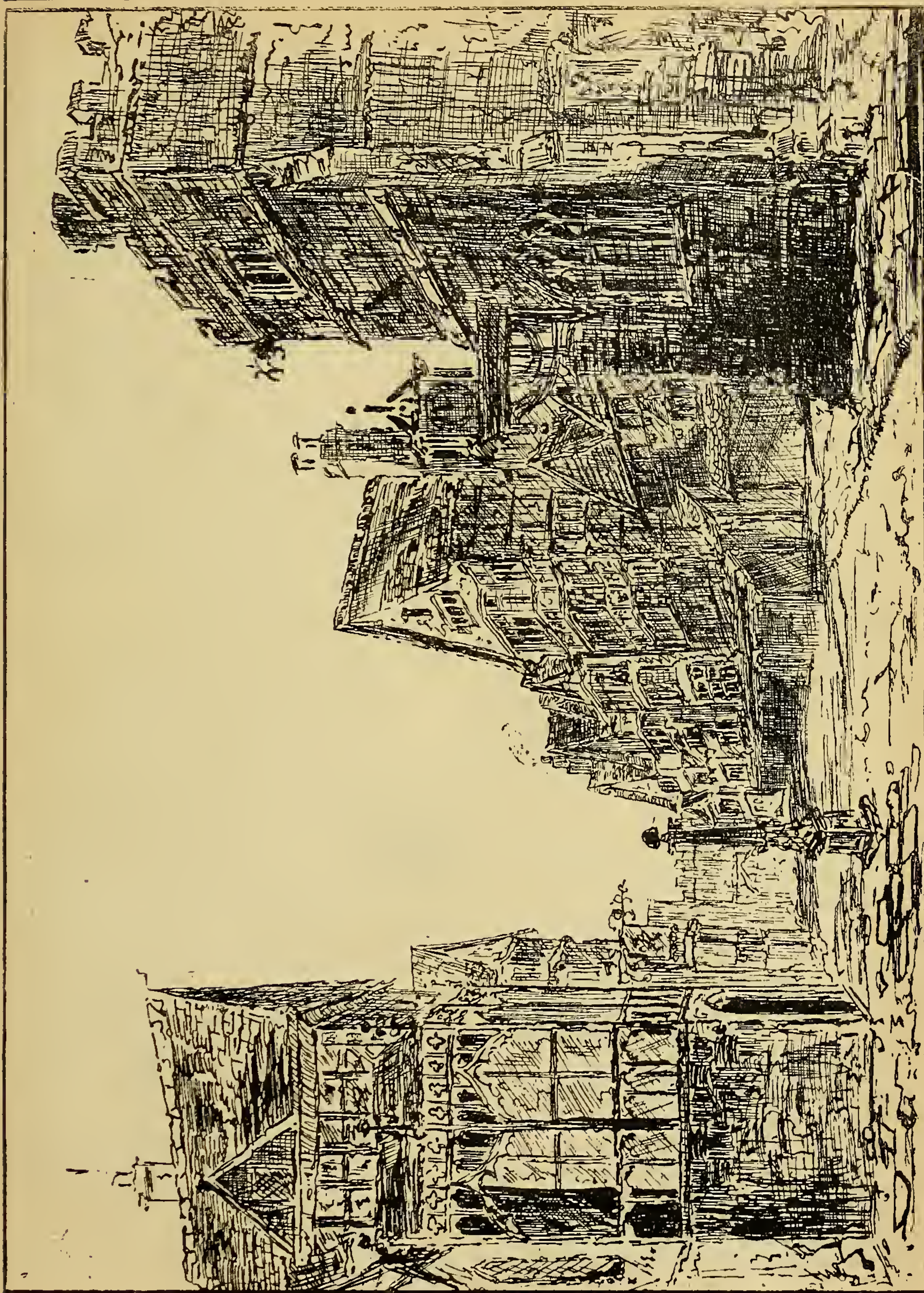


FIG. 80.—OLD ENGLISH STREET. ADAPTED FROM "OLD LONDON," INTERNATIONAL EXHIBITION, 1885.

supposed period of their existence. Nothing is more common than to see in scenes, for instance, the Roman Doric, when it should be the more simple Grecian Doric, or modern for the ancient Ionic, or the architecture of the Middle Ages confounded with that of the Classic periods. The Early English style is often introduced into scenes in which they could have had no existence. . . . . The forms of arches, it must be remembered, have their meanings especially in Gothic work, and decorative details do not belong indiscriminately—as many scene-painters imply they do—to any or every style of architecture at any or every period of the world's history."

These clever and studious remarks are very instructive and interesting, and coming as they do from so old a hand, should carry great weight with them, and be gladly welcomed by readers of these articles.

In painting scenes of this description for stock in a country theatre, one could hardly do with less than the following three subjects—viz., Modern English, Old English, and Foreign views. These three are for back cloths. A couple of "cloths" (one ancient and one modern) would also be required for use in the first or second "grooves," as perspective scenes are not permissible so low down the stage, although this rule, I am sorry to say, is often violated. It is therefore necessary in getting out any designs or models for this class of scene to see that the painting shall be in proportion to the actors on the stage. For back "cloths" perspective views can of course be introduced, but for cloths that hang lower down the stage this had better be avoided. All doors, windows, etc., must be painted life size, as the space between the "cloth" and the footlights is often so small, that the actors are often obliged to stand with their backs quite close to the canvas. It must be obvious to anyone that it looks very awkward, and out of all proportion to see the actors standing against houses, seemingly on the same plane, yet only a little higher than themselves, and sometimes not even so high. As this is a somewhat important matter, I shall in the next chapter give drawings of street scenes suitable for using in the front grooves of a stage, and, more so, specially adapted for the amateur stage, which as a rule is rather low for the proper display of exterior scenery.

Mr. Lancaster says: "I have often noticed in a country theatre where there are not too many scenes that a front scene has appeared like a street in Lilliput, and when the actor walks on he has the appearance of a Gulliver; this quite spoils the effect of the scene, and should therefore be carefully avoided."

As promised in the last chapter, in addition to Fig. 79, unavoidably held over, I now give a rough sketch suggestive of "an Old English Street" (Fig. 80). This is a different arrangement of "Old London" at the Kensington grounds, and would make an exceedingly pretty picture for a *back scene* if the necessary effect of light and shadow are skilfully manipulated as already set forth. It is a somewhat difficult subject as regards colouring to undertake, and I would therefore advise anyone who is a little at sea in this matter to obtain a coloured design and the necessary directions as to mixing up the colours from the gentleman who has undertaken to supply such. In making this suggestion, however, I should like it to be distinctly understood that I do not receive any pecuniary advantage from this part of the work, as I will not undertake to supply any drawings privately myself, and have accordingly left it entirely in the hands of the artist just named. On my part it is merely a matter of business and time, and would keep me from more valuable work. I make this explanation in answer to some correspondence which was lately addressed to me privately in anything but a kind way, and in reward for some trouble I had gone to in the working out of some small drawings. I hope shortly to wind up with exterior scenery, with instructions on painting a transformation, and follow on immediately with the painting of interiors, and some other miscellaneous items connected with the art.

(*To be continued.*)

DRY-PLATE PHOTOGRAPHY:

THE GELATINO-BROMIDE PROCESS.

By C. C. VEVERS.

V.—MATERIALS FOR DEVELOPING, FIXING, AND PREPARING PLATE FOR PRINTING.

I AM sorry to be compelled to commence the present chapter with a caution to buyers. Since Chapter III. appeared I find that the guinea sets Mr. Jonathan Fallowfield, 36, *Lower Marsh*, *Lambeth*, *S.E.*, is now supplying, are not like the one I examined and commented upon favourably therein. The "new" sets have neither reversing back, rising front, nor hinged focussing screen; the stand is weak, and the workmanship throughout very indifferent. I cannot, therefore, advise my readers to purchase one of these sets before first seeing that it has all the movements described in Chapter III.

To develope, fix and prepare the plate for printing, the following materials and chemicals will be required. I quote Fallowfield's prices, as I find his goods are much cheaper than, though equal to, those sold by other firms:—

Two or three ebonite dishes for 6½ by 4¾ plates .	at	10d.
ditto do. 4¼ by 3¼ ,, .	at	5d.
A set of scales and weights		2s. 0d.
* A non-actinic lamp or lantern.		

One glass funnel	8d.
One 4 oz. (1s.) and one 2 dr. (7d.) grad. glass measure	1s. 7d.
* A glass stirring rod	2d.
A few wide and narrow-mouthed stoppered bottles.	
1 oz. bottle Schering's pyrogallic acid	1s. 2d.
* A porcelain bath and dipper for 6½ by 4¾ plates	3s. 9d.
* A spirit lamp	1s. 0d.
Filter papers	8d.
* Plate draining rack	1s. 6d.

1 lb. liquor ammonia ·880	7d.	or	½ lb. sulphite of soda	4d.
2 ozs. potassium bromide	4d.		4 ozs. of sulphurous acid	6d.
1 oz. citric acid	3d.		4 ozs. carbonate of potash	6d.

1 gallon distilled water.	
1 lb. hyposulphite of soda (thio-sulphate)	2d.
1 oz. citric acid	3d.
1 lb. powdered alum	2d.
8 ozs. protosulphate of iron	1½d.
* 1 oz. bichloride of mercury	4d.
* 1 pint bottle of methylated alcohol	8d.
½ pint bottle of negative varnish	1s. 1d.

The chemicals must be perfectly pure, and it is also necessary that most of them, being somewhat deliquescent, be kept in stoppered bottles. None of the chemicals should be kept within reach of children, as they are all more or less poisonous; bichloride of mercury is a very active poison, and the bottle containing it should be distinctly labelled POISON; if it be taken internally the following antidote should be administered as quickly as possible: the whites of raw eggs mixed with milk or water, to be followed by emetics.

Plenty of stoppered bottles will be required; of narrow-necked (liquid) bottles there should be three sizes, say, four 20 oz., three 15 oz., and four 10 oz.; wide-mouthed bottles, one or two to hold 20 oz., one or two 10 oz., and a dozen 4 oz. bottles. The glass measures should be cylindrical, as they are more easily cleaned than are those of a conical shape.

Ruby lamps can be bought at almost any price, but the amateur should be able to make one for a few pence. Mr. Pocock, in page 19 of this volume, gives directions for making a portable lamp; an ordinary hock bottle, however, forms the simplest lamp I have ever made; there is but one difficulty in making it, that of cutting off the neck and bottom of the bottle, but that can be overcome with ordinary care. My first efforts to cut away the bottom of the bottle equally proved to be far from successful, and after going through the long list of well-known methods—which appear considerably easier on paper than they do in actual practice—I had for my trouble nothing but a waste of time and broken bottles. I at length hit upon the plan described in a back volume of "ours," and was, this time, entirely successful. A hock-bottle of a clear ruby colour should be selected. To cut off the neck and bottom obtain about six or eight yards of worsted, and wind it round the bottle at the place to be cut, keeping it as close together as possible; saturate the worsted with methylated alcohol and apply a light, keep the bottle turning round and round so that the heat is equally distributed round the bottle; immediately the light flickers out immerse the bottle in a pail of cold water, a crack will be heard, and with a few taps against the side of the pail, the part should drop off; of course, if the "click" is not heard the operation must be repeated. A tin cone should be made to fix over the top of the lamp, two strips of tin soldered to the inside of the cone acting as a clip. A base should be turned with a groove fully half an inch for the bottle to fit into, and a hole in the centre for the candle (Fig. 25). Several holes must be bored obliquely in the base, which should stand an inch from the bench on three brass-headed nails, for the entrance of the products of combustion. A cylinder of yellow tissue paper should be made to fit over the lamp to diffuse the light, and our "hock-bottle lamp" is complete. Total cost, 6d.

Light, unbreakable and watertight trays or dishes may be made with two or four-ply "Willesden" paper. A piece is cut about an inch and a half larger all round that the size of the plate, this amount is then turned up, the corners secured to the sides with ordinary paper fasteners, and the dish is ready for use.

Copy the following tables of weights on a sheet of paper, and paste it inside the lid of the box containing the scales and weights. If this is done, when weighing anything you will always have the tables directly before you.

APOTHECARIES' WEIGHT.*

20 grains	=	1 scruple	=	20 grains
3 scruples	=	1 drachm	=	60 „
8 drachms	=	1 ounce	=	480 „
12 ounces	=	1 pound	=	5760 „

AVOIRDUPOIS WEIGHT.

27·343 grains	=	1 drachm
437·5 „	=	1 ounce
16 ounces	=	1 pound.

WEIGHTS OF ENGLISH COINS.

One halfpenny and threepenny piece	=	¼ oz.
One florin and one sixpence	=	½ oz.
Three pennies	=	1 oz.
Four half-crowns and one shilling	=	2 ozs.
Forty-eight pence	=	1 lb. avoir.
One halfpenny	=	one inch in diameter.

Before giving directions for making up the different solutions required for developing, fixing, etc., I must describe the uses of the various chemicals

* It is important to remember that in all English photographic formulæ the solid and fluid measures of Apothecaries' Weights are used; but in buying and selling chemical articles the Avoirdupois Weight is used.

employed. If we were to remove the plate that has been exposed in the camera from the dark slide, and examine it carefully in ruby light, it would, unless the sensitive salts had received a prolonged exposure (*i.e.*, over-exposed or solarized), appear in exactly the same condition as it did previous to being placed in the slide and exposed, yet although no *visible* change has occurred, wherever the light has fallen on the sensitive film an important *chemical* change has taken place. Wherever the light has acted on the sensitive salts of bromide of silver, silver sub-bromide is formed, and bromine liberated, or to put it into chemical formulæ—

Silver Bromide = Silver sub-bromide and Bromine

$2\ Ag.\ Br. = Ag._2\ Br. + Br.$

It now remains to make the invisible or "latent" image visible. This is done by "development." The plate having been exposed in the focus of the lens, the invisible image is formed of variable quantities of the sub-bromide, approximately proportioned to the intensity of light acting upon it; on a solution of a deoxydizing or reducing agent, such as pyrogallic acid (pyrogallol) or protosulphate of iron being poured over the plate, oxygen is given off and nitrate of silver is deposited or precipitated on the invisible image. As development proceeds, the photographic image is built up of metallic silver by the crystals already deposited proportionately according to the variable quantities of sub-bromide forming the latent image, attracting a further precipitate of silver crystals, which are thus thrown down upon those parts acted upon by the light only. The visible or metallic image, therefore, is produced by the addition of fresh material to the parts which have been acted upon by light.

Pyrogallic acid is the oxygen-absorbing medium now almost invariably used as the developer, but, unless other chemicals are used in conjunction with it, its action will be very feeble; and, unless the plate has received prolonged exposure, no visible image will be produced. There are several chemicals employed for rendering the developer more energetic, ammonia being, perhaps, the most popular amongst English photographers. I will, as an example, describe the uses or functions of the chemicals forming the ammonia-pyro or "alkaline" developer.

Pyrogallic acid, as I have already explained, is the principal ingredient, and is *the* developer; without it it would be impossible to develope a plate. The greater the proportion of pyrogallic acid used in the developer, the greater will be the density and contrast between the high-lights and shadows in the resulting negative.

Ammonia accelerates the action of the pyrogallic acid and considerably shortens the time of development, gives density, and also slightly increases the amount of detail; but if too much be added the action has so much energy as to reduce or "veil" even those parts of the film that have not been exposed to light.

Bromide (of ammonium or potassium) is termed the "retarding" agent; it is used to restrain the action of the developer, and by making it slower to keep it more under control. Without the use of bromide the action of the developer would be so rapid, as to produce a general "fog" or veil all over the plate. It keeps the shadows clear, increases density, but keeps back detail to some extent. When potash or soda is substituted for ammonia, the action of the developer is much slower, and consequently the use of bromide is not essential.

I will give the formula for an "ammonia," and another for a "potash" developer. The amateur can then work with whichever he pleases, and I should advise him to give each a trial, and then adopt the one which produces the most satisfactory results in his hands. A good plan is to cut a plate, which has had a normal exposure, in two, and then develope one half with the ammonia and the other with the potash solution.

The makers usually enclose with each packet of plates "instructions" for developing, and a formula which they recommend the user to develope their plates with. Of course they give the one they consider, and which usually is, most suited to the peculiarities of their plates, but the beginner must not suppose that, for this reason, the plate cannot be developed with any other developer: a good plate should develope almost equally well with any of the standard developers if an unlimited quantity of *judgment* be one of the ingredients. I give the ammonia method preference, as it is the one most used by English photographers; the "ferrous oxalate" developer is, however, the favourite on the continent, while with our American cousins the potash developer is in general use.

All the bottles, before putting chemicals into them, should first be washed in soda and hot water, and afterwards rinsed out with clean cold water. The bottle containing the avoirdupois ounce of pyrogallic acid is opened, and to it is added six fluid ounces of distilled* water; the pyro will dissolve immediately; the solution should then be filtered into a stoppered bottle, and 70 grains of citric acid added to prevent discoloration of the pyro from oxidation. If it be more convenient 30 minims of pure nitric acid (which answers the same purpose) may be substituted for citric acid. The bottle containing this solution

* The description of a portable distillery for the purpose was described in Vol. IV., page 457.

(which will keep for some months) must be labelled P. STOCK SOL. For use, 1 ounce of the stock solution is added to 19 ounces of water, and labelled No. 1; this solution will only keep a few days. The next bottle, labelled No. 2, should contain 20 ounces (1 pint) of water, to which is added 3 drachms of strongest liquor ammonia. Into another bottle put 1 ounce of potassium bromide, fill up to 10 ounces of water, and label No. 3. The two last solutions will keep indefinitely if tightly stoppered.

So that there may be no error in making up the solutions, I give the formula in a tabulated form :—

P. STOCK SOL.

Pyrogallic acid .	1 oz. (437 grains).
Citric acid .	70 grains.
Water .	6 ozs.

No. 1.

P. Stock Sol.	1 oz.
Water .	19 ozs.

No. 2.

Ammonia ·880,	3 drachms.
Water .	1 pint.

No. 3.

Potassium bromide .	1 oz.
Water .	10 ozs.

For a correct exposure the developer should be composed of equal quantities of Nos. 1 and 2, and 30 minims (drops) of No. 3 to each ounce of solution. For $4\frac{1}{4}$ inches by $3\frac{1}{4}$ inches size, 1 ounce of developer will be required to cover the plate, and a $6\frac{1}{2}$ inches by $4\frac{3}{4}$ inches plate takes 2 ounces; so that to develope a $\frac{1}{2}$ plate, the following mixture will be required :—

No. 1 Solution	. .	1 oz.
No. 2 ,,	. .	1 oz.
No. 3 ,,	. .	1 drachm (60 minims).

No. 1 is the developer, No. 2 the accelerator, and No. 3 the restrainer. This fact must *never* be forgotten, as by a modification of the normal developer much can be done to counteract any error in exposure; thus *over-exposure* can be almost wholly overcome by an addition of No. 3, while, for *under-exposure* the proportion of No. 2 must be increased. The potash developer is made up as follows :—

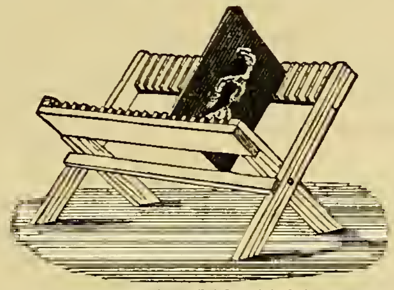


FIG. 27.—PLATE RACK OR HOLDER.

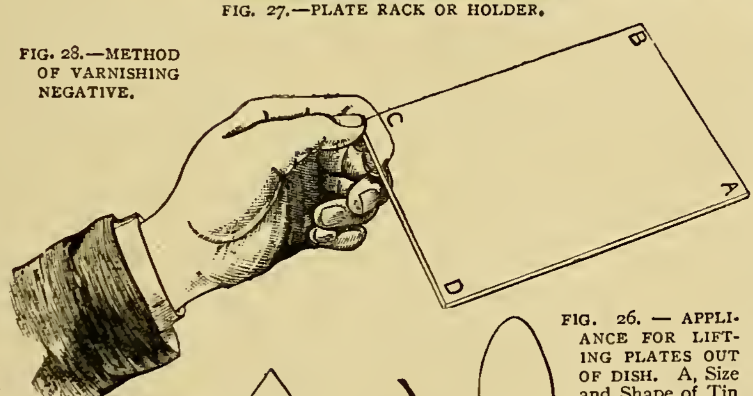


FIG. 28.—METHOD OF VARNISHING NEGATIVE.

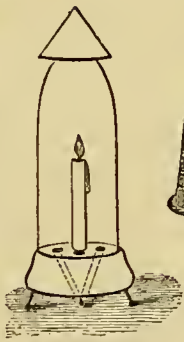


FIG. 25.—HOCK BOTTLE DEVELOPING LAMP.

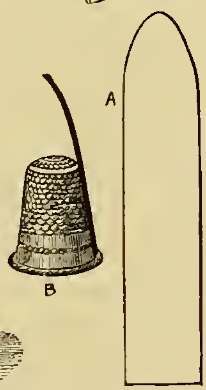


FIG. 26. — APPLIANCE FOR LIFTING PLATES OUT OF DISH. A, Size and Shape of Tin for Soldering to Thimble; B, Plate Lifter, complete.

A. (PYRO SOL.)

Warm water (distilled) .	4 ozs.
Sulphite of soda . .	$3\frac{1}{2}$ ozs.
Sulphurous acid . .	$3\frac{1}{2}$ ozs.
Pyrogallic acid . .	1 oz. (437 grains).

B. (POTASH SOL.)

Water	9 ozs.
Sulphite of soda . .	$2\frac{1}{2}$ ozs.
Carbonate of potash .	3 ozs.

When buying the chemicals, see that you are supplied with sulph*i*te, and not sulph*a*te, of soda, and that it is chemically pure. First dissolve the sulphite in warm water, and when cool, add the two acids. Filter and keep in stoppered bottle. B. solution is made by dissolving the sulphite in half the water, hot, and doing the same with the potash, and the rest of the water cold. Mix together when dissolved. To develope a $6\frac{1}{2}$ inches by $4\frac{3}{4}$ inches plate, add to two ounces of water forty minims of "A. Sol.," and flood the plate. Measure one drachm of "B. Sol.," return the first solution to the measure and again flood the plate. The image should appear in about three minutes, and be fully developed in from ten to fifteen minutes. For under-exposure add more potash; over-exposure is remedied by diluting the developer with twice, or even three times its bulk of water.

Myself, I prefer the potash to the ammonia developer. It takes up very little space in the dark room, two small bottles only being required, and it is exceedingly easy to work with; much more latitude in the exposure may be allowed than with any other developer, especially as regards over-exposure. The potash solution being comparatively slow in action, no restrainer is required, and time is allowed to counteract any error in the exposure, which I consider, especially for beginners, to be a great advantage; and,

lastly, no irritating fumes arise from the liquid to torment the operator whilst using this developer.

The following solutions will also be required:—

FIXING SOLUTION.

Hyposulphite of soda . .	1 oz.
Water	4 ozs.

Sufficient quantity is made by pouring the water, hot, over the crystals in the above proportion to fill the porcelain bath, or if the amateur has not obtained a bath, an ordinary tray or dish may be used, although not so convenient. The hyposulphite of soda (which will hereafter be termed "hypo.") solution may be used over and over again until it becomes very much discoloured.

CLEARING SOLUTION.

Alum (powdered) . . .	2 ozs.
Citric acid	1 oz.
Sulphate of iron . . .	3 ozs.
Water	20 ozs.

Dissolve by pouring the water over the chemicals, hot.

Everything being ready, the plate can now be developed. The proper media are placed in the small window of the dark room, the large window being covered with the opaque slide. The plate we are about to develope we will suppose to be $4\frac{1}{4}$ by $3\frac{1}{4}$ size; the developer to be employed is, in this instance, the ammonia-pyro solution. The developing dishes and measures are washed out; a $4\frac{1}{4}$ by $3\frac{1}{4}$ dish is placed opposite the window; to the right of this is the bath containing the fixing solution, and still further on is the clearing solution. Now shut the door, draw the curtain, and exclude all light, except that which enters through the non-actinic window; remove the exposed plate from the dark slide, place it *film side up* in the empty dish and cover it with water: the exact quantity is immaterial, it being used to soften the film, so that when the developer is poured on its action is more equal. While the plate is thus soaking, it is perhaps advisable to cover the developing dish with a larger one, to protect the plate from any stray actinic light. Measure out No. 1 sol. $\frac{1}{2}$ ounce, No. 2 sol. $\frac{1}{2}$ ounce, No. 3 sol. 30 minims; the water in the dish is poured off, and the dish being held in the left hand, the measure containing the developer in the right is rested on the edge of the dish, and its contents quietly, steadily, and without a splash, poured over the plate; the dish containing it at the same time being gently rocked or tilted from side to side so that the whole of the plate is flooded immediately; if this is not done a stain will in all probability ensue. Again, place the dish on the bench opposite the non-actinic window or light, and keep the solution continually moving over the plate; any air-bubbles that may adhere to the film must be blown away, or broken with a camel-hair pencil, as, of course, they prevent the developer acting upon the film directly underneath them, and if allowed to remain, will each cause a transparent ring on the negative.

The plate is now white, and appears exactly the same as it did when it was first taken from the plate box; if everything has been done properly, and the exposure has been correct, in from ten to twenty-five seconds, portions of the film will begin to darken, that part of the plate representing the sky will first make its appearance, and should be quickly followed by the high lights of the picture, such as a stream of water, white buildings, etc.; next will appear the half tones and minor details, and, lastly, the dark portions of the picture, the deepest shadows remaining white or transparent. This is, perhaps, the happiest moment of the photographer's practice; as he sits or stands in the dimly-lighted room, surrounded by chemical bottles and the like, watching the picture *he* has taken spring into existence, he will feel as proud as a rising artist whose productions have, for the first time, been "accepted" at the Academy.

All the details should be out, and the negative fully developed in about three minutes; it should be removed from the dish (and for this purpose I have found nothing better than an ordinary thimble to which has been soldered a piece of stout tin, as shown in the sketch, Fig. 26), held up by the edges, between the operator's eyes and the window, and examined by transmitted light; if the plate is fully developed and has received a correct exposure the high-lights should be opaque, and the deepest shadows perfectly transparent, yet every detail that was shown on the ground glass should be easily distinguishable in the negative; also if the back of the plate be examined by reflected light the image should just be visible. When the plate is fully developed and removed to the fixing bath, the contents of the developing tray should be emptied down the sink as they should not be used to develope another plate.

Before development, the glass bearing the film is called a "plate," after development it is termed a "negative." By negative we mean that the lights and shades of nature are reversed, that is, black and dark objects are shown as white or transparent, while white is represented on the negative as black or opaque. As the difference that exists between positive and negative must be perfectly clear to all, there is no necessity to make any attempt to illustrate it by engravings, although this might have been done by reproducing the illustrations by photo-mechanical process from a negative and positive of the same view, from which it would be seen that everything in the positive presents an appearance exactly opposite to that which it has in the negative.

When the plate is removed from the developing

dish, it is washed under the tap for a few minutes to remove all traces of the developing solution from the film. So that the water may fall on every part of the plate with equal force, a small brass "rose," such as is used with an ordinary garden hose, should be attached to the tap by a piece of rubber tube; this will cause a very fine spray of water to play upon the plate, which should be raised to a convenient height on a wooden support. The plate, when washed, is placed on the dipper, to which it adheres by capillary attraction, and lowered into the hypo bath. When the plate has been immersed in the bath for about a minute, white light may with safety be admitted as it has no further effect on the film, it being no longer sensitive to light.

If the reverse or glass side of the negative be examined before immersing in the fixing bath, it will be seen that the silver bromide that has not been acted on by light remains unaltered, and the back of the plate still has a whitish appearance. The object of the hypo bath is to dissolve out all the bromide of silver remaining in the film—"fixing" it, in fact, and this also renders the negative more transparent.

The plate must remain in the bath several minutes after all the *visible* bromide of silver has disappeared, when the negative must be again washed for five or ten minutes and then placed in the clearing solution for about ten minutes, or longer if the film be very yellow. The clearing bath serves a two-fold purpose: 1st, the alum in solution strengthens or toughens the film; and, 2nd, the citric acid and iron clear the film and remove the yellow-brown discoloration which is always more or less apparent on an ammonia developed negative. This discoloration is seldom seen when potash is used in place of ammonia, consequently, the clearing solution may be dispensed with when the former developer has been used; a saturated solution of alum must, however, be employed to harden the film.

The plate is removed from the clearing solution and thoroughly washed in running water to ensure perfect elimination of the hypo from the film for *at least* three-quarters of an hour. On this last thorough washing the lasting or keeping qualities of the negative depend. If the negative be a good or valuable one three or four hours' washing would not be too long.

When the negative has been well washed, it is allowed to dry spontaneously. On no account must heat be applied, or the gelatine will dissolve and run off the plate, as it is readily soluble in hot water; in fine weather, the negatives may be put out of doors where they will dry in about an hour, in doors they will be dry in from three to twenty-four hours; if many negatives are to be dried they should be placed in a plate rack, which is shown in Fig. 27.

The negative, when *perfectly* desiccated, should be varnished. This is an operation the amateur at first invariably fails to perform satisfactorily. Varnish is *not* particularly agreeable stuff to have clinging to one's hands and clothing, yet the beginner persists in forming a somewhat close and lovable acquaintance with this sticky though useful preservative; and more than one beginner have I seen with his fingers hopelessly stuck together. Like most other things there is a right and a wrong way of applying varnish, although there are, perhaps, more wrong ways than right ones. Hold the negative by opposite corners in both hands, and keep it moving a few inches over the flame of a gas stove or spirit lamp, with the glass side to the flame. Should any moisture condense on the back, it must be carefully wiped off or the negative may crack. It is rather difficult to show on paper the exact heat the negative must be brought to, but a fair test is to lay the plate on the back of the hand, when it should not feel inconveniently hot; if the negative is too hot the varnish will not flow easily, if too cold the varnish will dry with a "tacky" matt surface. The plate is held by one corner with the thumb and first finger of the left hand, sufficient varnish is poured on the centre to half cover the negative; it is then run, steadily and without haste, to the top right hand corner (A, Fig. 28), then to the left top corner (B), down the left side to the thumb, and finally the surplus is drained off at the right hand bottom corner (D) into the bottle, resting the corner of the plate on the mouth of the bottle, and at the same time slowly rocking it from side to side to prevent the varnish forming on the plate in streaky or "crapey" lines. When all the excess of varnish has run off, the negative is heated as hot as the hand will bear, and then allowed to cool gradually, when it is ready for printing from.

In the event of failure the varnish can be removed by the application of methylated spirit, as described in answer to a correspondent in page 190, Part 51.

We must now consider the method of treating over and under-exposure; but, first, how are we to tell when a plate has been inaccurately exposed?

We pour the normal developer over the plate, the image, instead of appearing in about twenty seconds "springs" or "flashes" out instantly or within a second or two of the solution touching the film; the half tones follow immediately, the whole film blackens in a very short time, and if we were to continue development as usual for about three minutes the negative would be opaque all over. If, however, we were to stop development at the end, of, say, a minute, we should have a very thin, weak and flat negative, devoid of the necessary opacity in the high-lights, fogged in the

shadows, and wanting generally in density and "brilliancy." It will be quite evident the plate has been over-exposed.

With under-exposure, on the other hand, the image is slow to appear; with normal developer the high-lights will creep up in from one to four or five minutes, very little half-tone will be shown, and presently all action ceases, and the only result of keeping the developer on longer is to stain the film with ammonia. The negative, if examined, will appear hard and harsh, the high-lights quite opaque, and the rest of the plate (including the half-tones) more or less transparent.

Over-exposure.—If the plate be known to be over-exposed, or if there is the least fear of over-exposure, make up the developer thus:

No. 1 Sol.	1½ oz.	half plate.
No. 2 Sol.	¾ oz.	
No. 3 Sol.	90 minims	

It will be seen that we increase the quantity of pyro and bromide, and reduce that of the ammonia; the exact quantities, however, should be modified according to the amount of over-exposure the plate has received. Should the image not appear in thirty seconds, No. 3 may be increased drachm by drachm. When the normal developer is used, if the image flash up immediately, pour off the solution without delay and flood the plate with water; make up a fresh developer as above, and proceed as usual. When the potash developer is used, over-exposure may be remedied by the addition of *plenty* of water.

Under-exposure.—Very little can be done to remedy under-exposure. If the image does not appear in due course, the solution is returned to the measure, and from half a drachm to half an ounce of the accelerator (No. 2) is added. (I would say in parenthesis that an addition of any solution should never be made directly into the developing tray, but the developer must *always* first be poured back into the measure or cup, so as to ensure a perfect mixture.) If detail is not produced by this addition the plate has been hopelessly under-exposed, and the film should be cleaned off while still wet, or, as Abney jocosely says, the plate should be "framed for the benefit of beginners." If the plate be only slightly under-exposed, careful management *may* produce a fair printing negative. Development should not be pushed by an excessive addition of ammonia or the film will be fogged or stained by its action. Detail in the shadows, etc., can be brought up to some extent by breathing or blowing on that particular portion of the film: the warmth of the breath makes the developer more energetic.

Defects and failures in negatives and their remedies, must be dealt with in the next paper.

(*To be continued.*)

SHAVING GLASS IN FRETWORK.

By J. W. GLEESON WHITE.

(*For Illustrations see the Folding Sheet issued with this Part.*)

THE piece of fretwork of which full size designs are furnished in the Folding Sheet given with this part, is not very complex in its treatment; but to avoid the necessity of giving in addition to these, full size working drawings of the plain wood parts and the fittings, it seemed necessary to supply some description of the mode of fitting it together, and the meaning of the various parts.

It will be seen from the disposition of the parts on the sheet, that the centre glass swings after the fashion of an ordinary toilet glass, while at the foot, as in the old box mirrors, there is a compartment to hold razors, etc.; while on either side receptacles are provided to take one of the blue and white Japanese cups sold at a penny each everywhere. These would do for the shaving soap, or serve as tidies to contain the loose studs and other trifles that invariably are found in the neighbourhood of a toilet table; while, if needed, hooks in the side might hold a watch or pedometer.

The plan consists of a base piece of wood, the size shown; the two pieces, E, E, are mortised into this; if desired, the mortises may be long enough to go right through the bar, and be secured by bolts or pegs of wood. If this be done, four knobs must be added to base to give a firm standing. In any case, small knobs stand better than one flat base, which is rarely quite satisfactory, even when covered with green baize.

The glass itself should be in a plain wood frame, the size of square of fretwork, with the rebate to take glass; the fretwork (silk lined) should be fixed with glue on the rebate, so that it is impossible for the glass to come out. It is as well to line the glass with flannel or baize to prevent it shaking, reducing the breaking possibility at the same time.

Screws or pegs passing through the holes F should carry swing glass in usual way; these holes should be left until the last, to ensure their being in the right place. The pieces, B, B, may be screwed to back; also a plain piece, 1⅛ inch all round plan to form the box. This is best dovetailed at corners in box fashion, if practicable.

The piece, D, should be hinged to a plain piece of wood, an inch wide, before fixing, so as to open well clear of swing. The piece, H, should be fitted (perhaps a little wider than shown) firmly between uprights E, E; better if mortised in, as it helps hold them together. The box compartment between E, E, with

cover D, may be divided to take razors and shaving brush, this should be lined with tinfoil or tobacco lead, to minimise the chance of damp brushes, etc. The pieces, C, allow a penny Japanese cup to sink into them, and may be left open, or silk lined like the lid, D, and the glass, A. It would be best to put a thin wood lining everywhere in place of silk, if it can be done. In that case, a piece of ¼ inch wood cut exactly to outline of glass, A, with circle an eighth of an inch larger would strengthen glass, and make rabbet for the round glass to drop in, while the piece that was cut out, planed down, inserted again would make the back tidy and keep the glass in.

These few directions will bef ound sufficient to construct the glass as intended; but if any item is not clearly explained, a query to "Amateurs in Council" will always be noticed, and the missing information supplied.

CIRCULAR SAW BENCH,

WITH PLANING, GROOVING, REBATING, AND MORTISE-BORING ATTACHMENTS.

By OLLA PODRIDA.

III.—Construction of Fly-wheel—Speed Pulley—Crank-shaft—Centres and Plate Nuts for Crank-shaft—Spindle and Fittings—Bearings.

WE now come to the building up of the fly-wheel. This important member must be made of the heaviest wood procurable, in order that its efficiency may be rendered as high as possible. If a suitable cast-iron wheel can be conveniently obtained, it should be employed, being, as a matter of course, infinitely superior to wood. But metal costs money, and the object in view being, in most cases, a saving of the latter commodity, a serviceable substitute of a cheaper nature must be selected, and a wooden fly-wheel, constructed of timber having a high specific gravity, and in addition ballasted with sheet lead properly distributed, will be found to answer very well. To this end teak may be employed, if obtainable ; if not, the next best and most easily obtained material would be pitch-pine. For the making of the rim, African oak would be best by far, if it could be procured, but in the majority of cases I fear this would be difficult. For the arms, ash, pitch-pine, or any convenient timber of moderate hardness and toughness may be employed.

We will now turn our attention to the construction of the fly-wheel in detail. Each member will be described in the order in which it should be taken in hand and the different operations carefully described as fully as possible. Before entering upon the details, a brief description of the arrangement of the different parts and their relation as a whole, will not be out of place, and may assist to a clearer comprehension of the different processes.

The wheel, when complete, consists of three layers each 1½ inches thick. The first layer forms the largest speed, which is 26 inches in diameter, and consists of three pieces, viz., two portions of a ring and one arm, as shown at Fig. 32. The next layer, forming the second speed, 25¼ inches in diameter, is made up in a similar manner, as shown at Fig. 33. The last layer, or third speed, 24½ inches in diameter, is composed of four segments, arranged so as to break joint with the arms, as will be seen at Fig. 35. A fair idea of the general features having, it is presumed, been gathered from the foregoing, the details may now be entered upon.

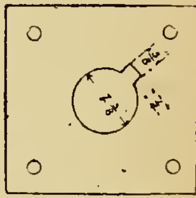


FIG. 38.—CHEEK PLATE. Two in Number; one-fourth full size.

The arms should be made first. These are given in Fig. 36 by two views, drawn to a scale of one-fourth full size. They are of different lengths, but in the illustration one drawing is made to do duty for both by the insertion of figured dimensions. The one for first layer is 2 feet 2 inches, and for the second layer, 2 feet 1¼ inches in length when finished. Each must be cut half an inch longer in the rough, as noted by asterisks, to allow for finishing. The difference in length affects the arms from B to C only, so that in all other respects they are alike. A piece of timber 4 feet 4½ inches long by 4 inches wide and 1⅝ inches thick, will suffice for the pair. First plane up the stuff to the proper thickness, and cut to the proper lengths. On one side of one of the pieces mark off the proper outline as per Fig. 36. If one arm is finished off to the lines at first, it may be used as a template for the remaining one. In marking the first—which is also the longest one, corresponding to the largest speed—set out a length of 26½ inches from one end, and cut off. The remainder will form the second arm, corresponding to the second speed. Returning to the first, and proceeding with the marking of the outline, the first thing to be done is to find the centre, and on this centre describe a circle 4 inches in diameter, and from the same centre, with 8½ inches radius, set off the shoulders at B. Now gauge a centre line lengthwise from end to end, and at the intersection of this centre line with the 8½ inches radius already described, set off on each side of the

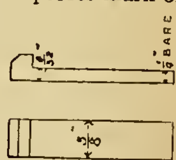


FIG. 37.—KEYS. Two in Number; half size.

centre line at each end of the stuff the width of the arm at the shoulder—viz., 2½ inches—and gauge this width on each side out to the ends. Square lines across tangent to, or just touching, the 4 inch circle at the centre, for guidance in forming the tapered parts. The arm is now marked ready and complete for cutting out to shape. This may readily be done with a saw and paring chisel. To mark the second arm, the first one must be laid upon the blank, and lines scribed round it with a pencil or steel scriber. The corners of the tapered parts may be chamfered, or otherwise treated, according to fancy. The arms may now be considered complete.

The rim will occupy our next attention. To make the first layer forming the largest speed, Fig. 31, a piece of board 3 feet 1 inch long, by 17 inches wide will be required. The thickness must, as a matter of course, correspond to that of the arms. For marking out the segments of the rim, templates are employed. Those for the first and second speeds are shown in Fig. 31, and the one for third speed is given in Fig. 34. These templates may be made out of brown paper or cardboard. The grain of the timber must be arranged in accordance with the arrows shown in figure. The construction of those shown in Fig. 31 will be comprehended at a glance, seeing that they consist of semicircles shortened by 1¼ inches, as shown from the centre line. R denotes the *rough* size to which the timber must be cut out, and F denotes the *finished* size when turned up. In the case of the inside radius no allowance need be made if the marks or templates are carefully followed. The template in Fig. 34 is a quadrant of a circle, the ends of the segments being at right angles or square to each other.

We will now return to the actual building of the rim. The first thing to be done is to choose a place whereon the wheel may be built. This must, of necessity, be level or fairly so. The top of a spare bench or old table, or even the floor, if the latter is of wood, will answer so long as it is tolerably level, and permits of nails being driven into it to secure the work while in progress. The site for building operations having been selected, the first thing to be done is the describing of a circle upon it, equal to, or preferably, slightly exceeding, the rough diameter of the largest speed, viz., 26½ inches. This circle forms the guide in fitting the first two segments and arm together. The arm should first be set in position across this circle, and the segments afterwards butted carefully against it, care being taken that when fitted their periphery agrees with the guiding circle. To facilitate the setting of the arm a diameter must be drawn across the guide circle upon the floor, and the correct width of the ends of the arms, 2½ inches, set off, and equally divided on each side of the line forming the diameter; this done, the arm must then be carefully set to the marks, divided equally lengthwise in relation to the guide circle; and, lastly, when this has been satisfactorily accomplished, it must be securely fixed by means of light nails driven into the floor and against the ends, and on each side of tbe centre of arm. The segments can then be butted or fitted with certainty, and without fear of mishap through shifting. When they, the segments, have been properly fitted, a few light nails must be driven into the floor around their edges to keep tbem in position during the operation of fitting the second speed or layer.

The second speed is similar in detail to the last described, in that it also consists of one arm and two segments, but of slightly smaller dimensions. To make the segments, a piece of stuff 3 feet long by 16¼ inches wide, and 1⅝ thick, will suffice. The grain of the timber must be arranged as previously noted. A line must be drawn across the centre of the first speed as it lies upon the floor, care being taken to ensure that this line is set out at right angles to the arm in place. The width of the second arm must be set out and equally divided on each side of this new ine where it crosses the first rim. The second arm must then be carefully set to these marks, and permanently secured by means of stout wood screws 2½ inches long and about ¼ inch in diameter. The disposition of the fastenings is clearly shown in Figs. 33 and 35, and must be noted so that they may be steeied clear of in securing the third speed. The segments of second speed are to be next fitted and secured permanently, care being taken in butting them against the arms so that the inside and outside may agree with the first as well as possible. The upper face of the rim should now be smoothed over with a hand plane, so that any existing inequalities, likely to interfere with the fitting of the third and last speed, may be removed. Of course, the partly finished wheel may now be removed from the floor, and handled according to necessity.

The third speed differs in detail from the first and second, in that it consists of four segments or quadrants, arranged so as to break joint with the arms as shown in Fig. 35. This portion of the rim can be economically cut out of a piece of stuff 5 feet 10 inches long by 6½ inches wide, according to the template given in Fig. 34. In butting tbe members together the first should be squared at the ends to a right angle, then set in position and permanently secured. The otbers must be taken singly in like manner, and secured in turn as they are fitted. The wheel is now complete except for turning the rim, boring of the eye, and fixing of cheek plates to the same.

In boring the eye or centre to fit the crankshaft,

great care must be exercised in marking it out. This must be done from both sides, the centre being marked accordingly. The marking of the centre should be done with a radius from four points on outside of rim, the arms being taken as guidance in doing so. In addition to this it should be checked from the inside to ensure truth and balance of the rim as much as possible. The cheek plates may be cut out of stout sheet iron, say $\frac{1}{8}$ inch thick, if obtainable. These plates are to be 4 inches square, with clearing holes for $\frac{1}{4}$ inch bolts, drilled in the corners to correspond with those marked *a a* in Fig. 36. Keyways must also be cut in each plate, and also in the wood, so that the wheel may be secured upon the shaft by means of tapered keys. That this may be made clearer to the amateur, illustrations of the plate and keys complete are given herewith in Figs. 37 and 38. Care must be exercised in "setting" the wheel on the crank shaft so that it shall "run" truly; and to accomplish this matter conveniently the wheel and shaft should be hung in place between the centres and the keys manipulated according to the state of the wheel. A few practical experiments on this "setting" process will throw more light on the matter than a page of instructions to the amateur.

The fly-wheel has yet to be turned and speeded on the rim. This will have to be accomplished in place when hung between its own centres. For supporting the tool during the operation of turning, a rest may be extemporized by fixing with screws a piece of hard wood on the front of the right hand leg of machine. It may be possible to do the job single handed, but assistance had better be sought in the form of someone to "treadle," so that the whole attention may be given to the turning. The largest speed should first be turned to 26 inches diameter, and the remaining two turned so as to give steps of $\frac{3}{4}$ inch from first to second and second to third. Each speed should be rounded slightly and evenly from the middle to each edge or corner, as shown by accompanying diagram, Fig. 41. This is for the purpose of steadying the driving band, and assisting it to keep in place. Should it be found necessary to add to the weight of the rim, sheet lead may be nailed to the left hand or largest side of it, there being no room to spare on the right hand. Flat-headed nails, commonly called "clout nails," should be used for securing the lead, which should be cut to shape of rim, and flattened evenly before attaching.

Speed Pulley.—This is the next, and in wood, the last item. A section and an end elevation of this detail are given in Figs. 39 and 40. It should be made of hard tough wood, such as ash or beech. A cylindrical piece $6\frac{1}{4}$ inches long and $3\frac{1}{2}$ inches diameter in the rough will suffice, if the centre hole is bored truly, otherwise it would be safer to take a piece 4 inches diameter to allow for "running" of the hole. The centre hole must be carefully bored with a sharp screw, or shell auger sent through from one end, on which the centre of the piece has previously been marked. This end from which the hole is bored should also be that chosen for the largest speed. To ensure its fitting, a trial hole should be bored in any convenient block of wood, and the spindle tried in it before risking the blank.

The first thing to be done after boring is to mount the blank on a wooden mandrel, or, better still, its own spindle, providing that it has been made a thorough tight fit. Now put it in a lathe and turn down the ends at *b*, *b*, for the reception of the bands shown in black. These rings or bands may be cut off a piece of pipe $1\frac{3}{8}$ inch internal diameter, and may be of iron, brass, or copper. They are each about $\frac{1}{2}$ inch in length. They should be rounded out a little on the inside corner at the inner end, and the wood slightly tapered so that they may be driven on very tightly. This done, the key ways at *a*, *a* for receiving the keys, shown at Fig. 42, may be cut with a $\frac{1}{4}$ inch mortise chisel, and presuming that the keys have been prepared, the pulley may be fixed upon its own spindle and turned down to the proper size, viz., large speed $3\frac{1}{4}$ inches, second speed $2\frac{1}{2}$ inches, and third speed $1\frac{3}{4}$ inch in diameter, measured in each case on the centre or middle of the speed. It will be observed that the smallest speed is longer, or wider than the others by a $\frac{1}{4}$ inch. This is to allow for oscillation of the belt when running fast. The faces of each speed must be smoothly sand-papered at the finish.

Crank-shaft.—This is shown at Fig. 45. It is made of round bar iron $1\frac{3}{8}$ inch diameter, with a total throw of $3\frac{1}{2}$ inches. The lengths are given from the centre of dip. The ends are drilled and cored or countersunk to suit the centres, and afterwards thoroughly case hardened. The dip need not be turned at *a* : if carefully filed with a round file checked by frequent gauging with callipers, it will work quite as well practically. At *b*, where the fly-wheel is hung, the end should be tapered slightly by means of filing, so that it may drive well and tightly into the eye of wheel. In centring and drilling the ends, great care must be exercised to ensure that the shaft may run truly. The ends should first be filed off flat, and the centre gauged with compass callipers or anything else handy. A small centre must first be made, and the shaft tried between its own centres. When correctly centred, the cored or countersunk part must be drilled *first*, and the clearance hole made afterwards.

Plate Nuts and Centres for Crank-shaft.—Fig. 43 shows the nuts. They are made of $\frac{1}{8}$ inch plate

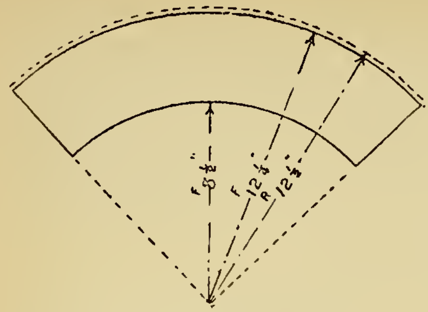


FIG. 34.—TEMPLATE OR MOULD FOR SEGMENTS OF THIRD LAYER.

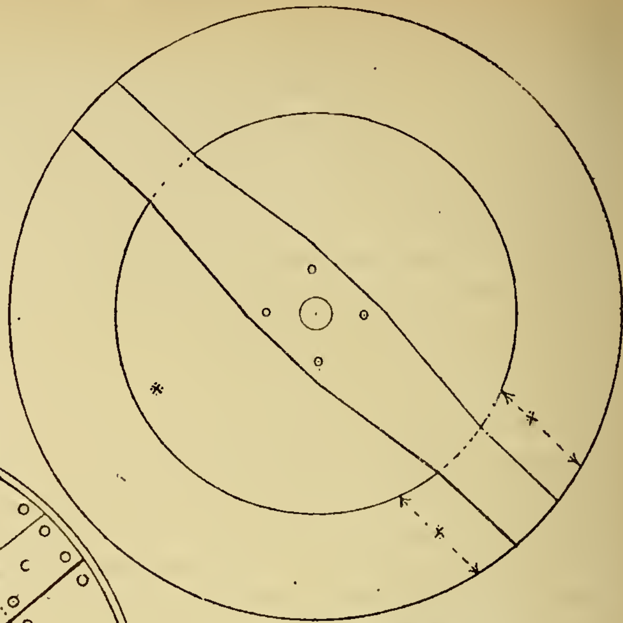


FIG. 32.—FIRST STAGE.
Arrows denote direction of grain of wood.

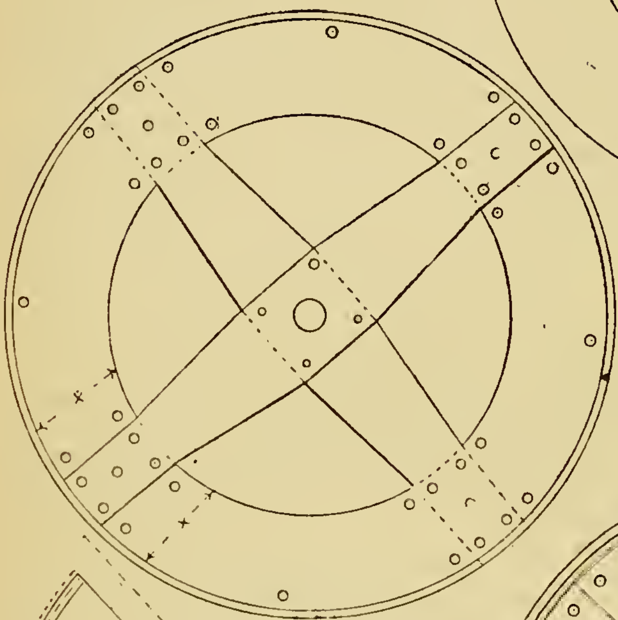


FIG. 33.—SECOND STAGE.

DETAILS OF FLYWHEEL CONSTRUCTION.

Scale, 1½ inches to a foot, or one-eighth full size.

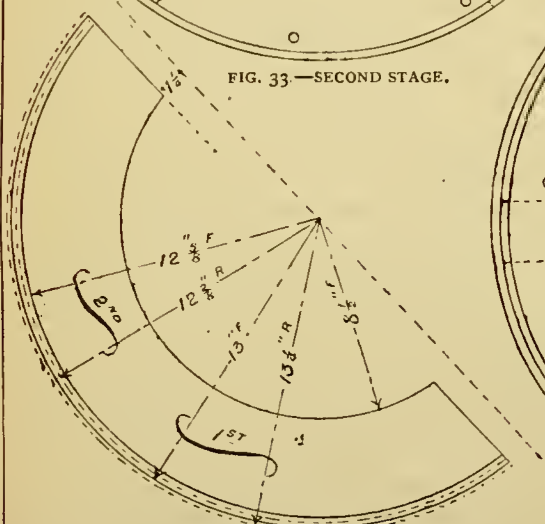


FIG. 31.—TEMPLATE FOR FIRST AND SECOND LAYERS.

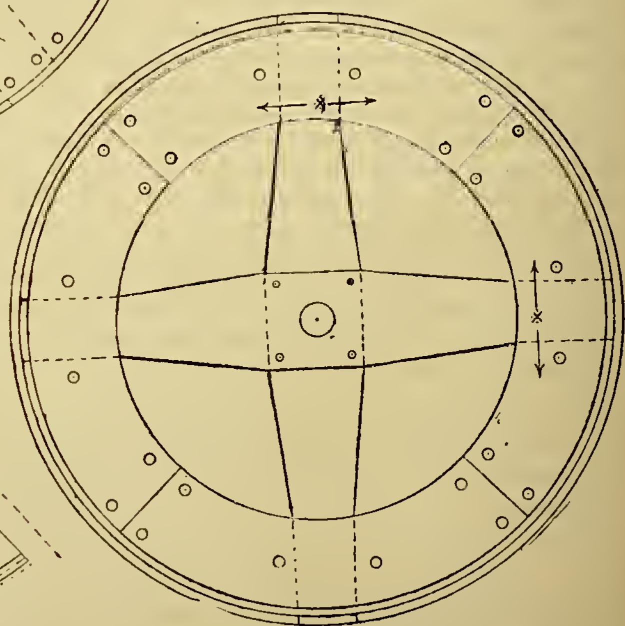


FIG. 35.—THIRD AND LAST STAGE.

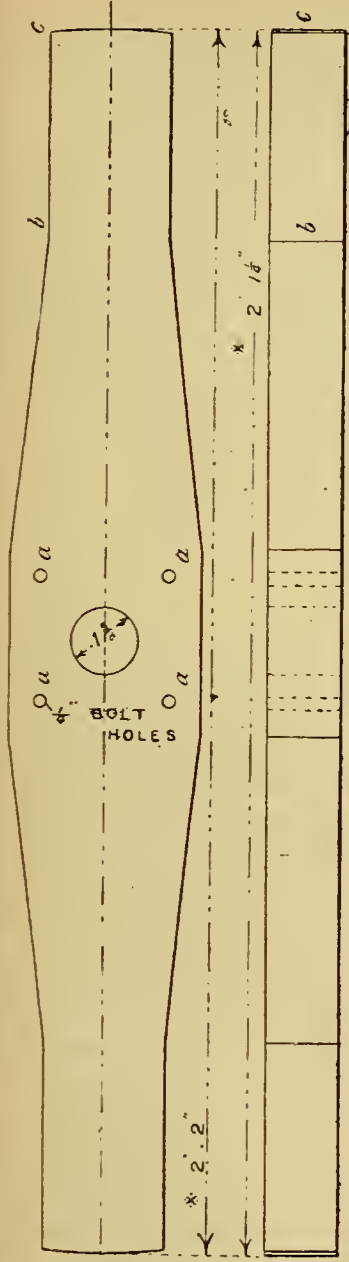


FIG. 36.—ARMS FOR FLYWHEEL. Two in Number to different dimensions. * Half inch longer in the rough to allow for turning.

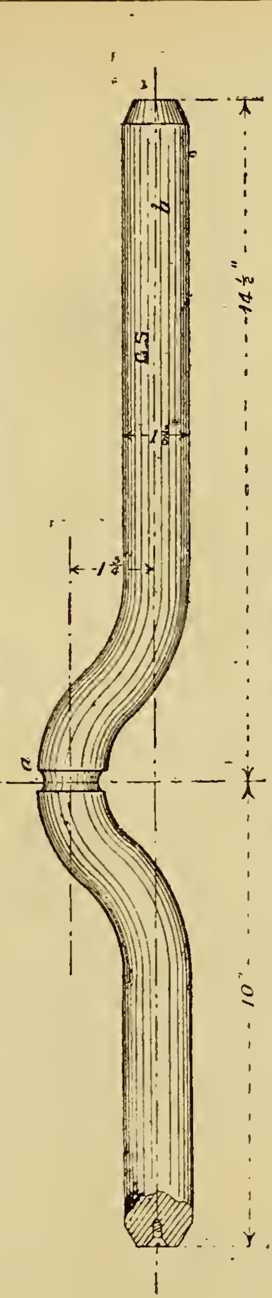


FIG. 45.—CRANK SHAFT. One in Number.

FIG. 44.—CENTRES FOR CRANK SHAFT. Two in Number.

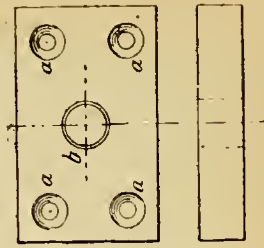


FIG. 43.—PLATE NUTS FOR CRANK SHAFT CENTRES. Two in Number.

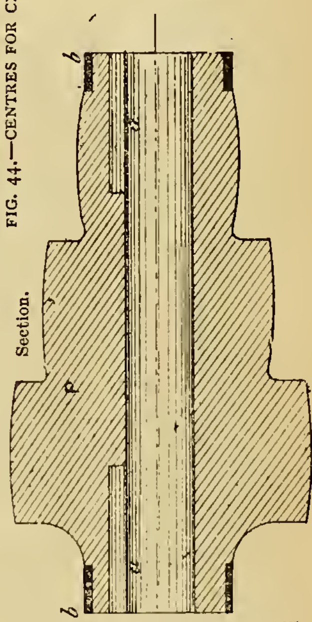


FIG. 39.—CORE PULLEY FOR SAW SPINDLE—SECTION. One in Number.

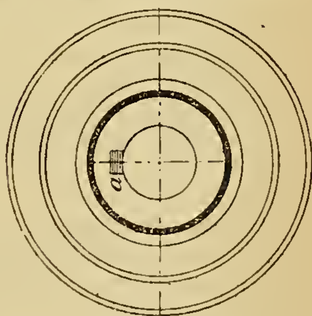


FIG. 40.—END VIEW OF CORE PULLEY.

DETAILS OF FLYWHEEL, ARMS, AND DRIVING GEAR.—Note.—Figs. 36 and 45 drawn one-fourth full size. Figs. 39, 40, 42, 43, and 44 drawn half size.

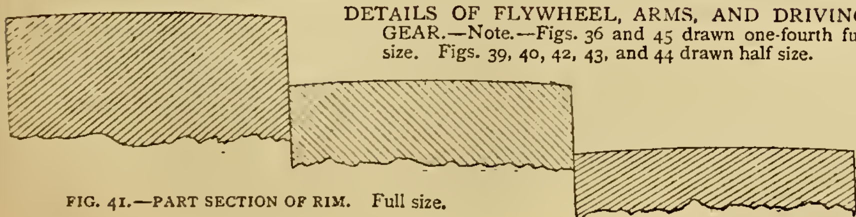


FIG. 41.—PART SECTION OF RIM. Full size.

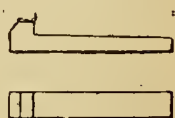


FIG. 42.—KEYS FOR CORE PULLEY. Two in Number.

$2\frac{1}{2}$ inches long by $1\frac{1}{2}$ inch wide, with a $\frac{1}{2}$ inch tapped hole at *b*, and holes for stout wood screws drilled and countersunk at *a*. The centres, as shown by Fig. 44, are $\frac{1}{2}$ inch diameter and $3\frac{5}{8}$ inches long between head and nut. The point should be tipped with steel, and thoroughly hardened after the centres have been finished. A hexagonal nut is not imperative. A square one will do quite as well. The screwed parts should be fitted tightly so that they can only just be moved with a spanner 3 inches or 4 inches long.

Spindle.—This is given in detail upon the Folding Sheet in Part 54. The making of this part is rather beyond the average amateur. On the left hand end at *a*, a left-handed thread is required, the cutting of which requires special tools. A right-handed thread is shown in the sketch through an oversight of the writer. At *e* the thread is right handed. The collar at *c* may be made solid with the spindle, but when made separate, as shown, end play may be taken up from time to time as may be required. The hole at *b* is for the insertion of a tommy, so that the spindle may be prevented from turning while the nut is being tightened or slackened.

In the washer for saw spindle a small pin is shown at *a*. This is to keep the saw from slipping round. It also prevents the washer from turning so that if the machine is only to be used for sawing purposes, a right-handed thread might be ventured at *a*, provided that it was made a tight fit.

The bearings should be made of brass, although cast iron would answer very well if kept well lubricated. If preferred, they may be made solid, and in that case, would be much cheaper ; but a great drawback would be that when slackness arose there would be no means of adjustment.

I would enter into further detail of the bearings, but space will not permit. The same reason forbids my entering upon a description of the necessary patterns. However, should any amateur think it worth while to take the matter up, I will gladly assist through the "Council."

The Britannia Company, *Colchester*, will, I am sure, be happy to supply the whole or any of the metal parts at most reasonable rates to intending builders. I may venture to state that it will only be necessary to enumerate the parts required, and quote the Part of AMATEUR WORK in which they are illustrated.

In the next chapter I hope to describe the planing arrangements, and then in another and concluding chapter I will endeavour to enumerate in a descriptive manner the different uses to which the machine, as a whole, may be put.

(*To be continued.*)

HOW IT WAS MANAGED.

A SERIES OF PRACTICAL HINTS, SUGGESTIONS, AND WRINKLES.

FROM AMATEURS FOR AMATEURS.

XXI.—SILVER OR METALLIC TREES.

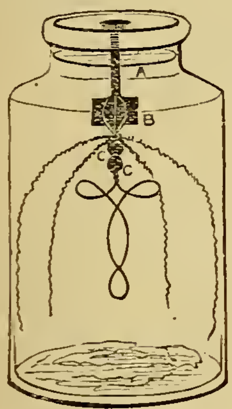
[*From* TOMMY DODD.]

THESE trees are very simple to make and have a very pleasing effect when made. It is almost as cheap to make twenty or thirty as it is to make one, so I will suppose you are going to make several, and will describe the materials accordingly.

Materials Required.	*s.*	*d.*
Spelter, about one pound	0	3
Acetate of lead, half pound	0	5
Brass or copper wire (penny rings)	0	2
Acetic acid	0	2
Glass bottles (old pickle bottles)	0	0
Total	1	0

I don't know the address of any firm where you can get the spelter in small quantities, but I have no doubt you could get it from any dealer in metals. I got mine from someone who had purchased a large quantity. The acetate of lead and the acetic acid can be got at any chemist's or drysalter's. The wire is sold by ironmongers and fancy dealers in penny rings. For the glass bottles old pickle bottles are the best, these no doubt you can get from the kitchen. To start, first take the wire and cut off three pieces about a foot long, or a little more than twice the height of your bottle, put them together, double them and twist them together for about an inch ; cut off a small piece of spelter about half an inch square, and fix it just below the twisted part of the wire (as in engraving), then twist the wires again underneath to keep it in its place, then take two wires and thread two or three coloured beads just to give effect, then continue to twist the wires and fasten a china doll on the end or twist to a fancy design, and stretch the remaining four wires out for legs or branches. When your tree is complete take about a teaspoonful of the acetate of lead and dissolve in a cupful of boiling water, when cool pour it into your bottle and fill up with cold water, adding two or three drops of acetic acid. To fasten the wire tree to the cork or bung, make a slit and pass the wire along it, then compress the wires slightly, and put the tree in bottle when the legs will spring out against the sides. It is better not to allow the wires to touch the bottom. After about five minutes the spelter (which must be under water) will blacken, and in an hour or so will seem to swell out, and in the course of a day or two the wires will be covered with lead crystals, giving the most beautiful effect. Sulphate of zinc will do instead of the acetate of lead and acetic acid, but it takes longer and is not so nice. One word of caution.—Don't leave the acetate of lead where there are children, as it is poison.

It may be objected by some that this is a very old process, and it must be freely acknowledged tbat it is so. However, every experience and experiment must be new to tbe person to wbom tbe former occurs or by whom the latter is essayed for tbe first time, no matter how old and devoid of interest it may be to those who have tried it before, and in trying it have extracted from it all the enjoyment that it can yield. Doubtless, it will be new to many readers of AMATEUR WORK, and it is in tbe interest of these that I have ventured to describe once more the simplest process of making "metallic trees."



SILVER OR METALLIC TREE.
A, Water Line; B, Spelter; C, C, Glass Beads.

XXII.—HOUSEHOLD MEDICAL CABINET WITH CLOCK.

[*From NEPENTHE.*]

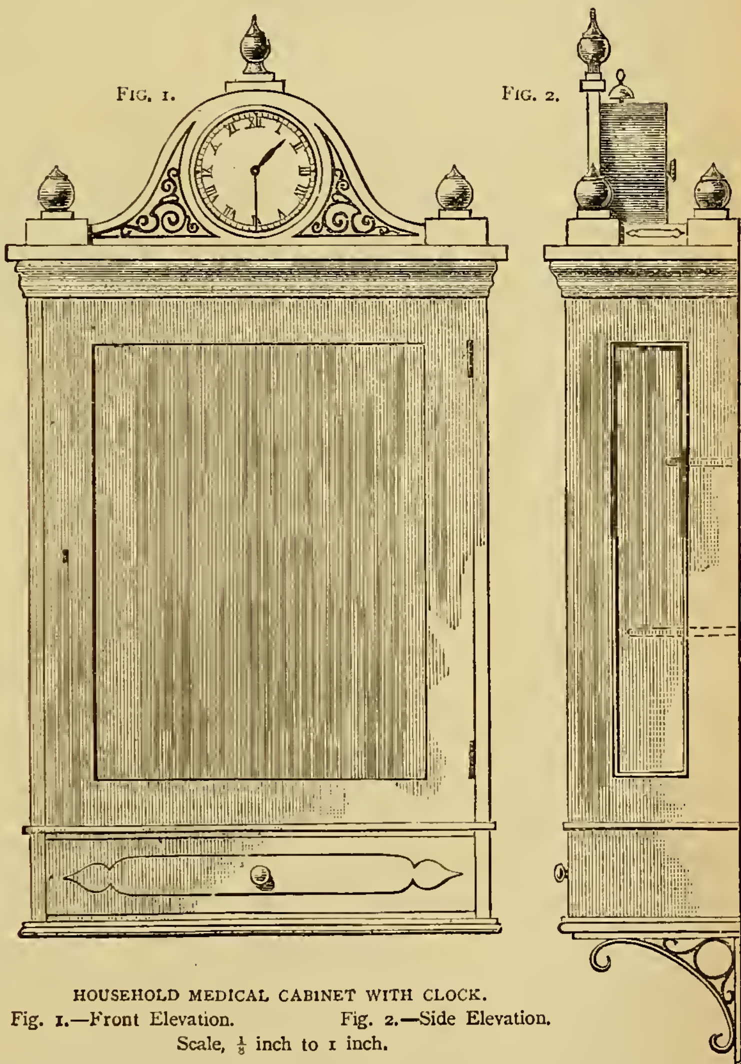
I HAVE noticed, from time to time, requests from correspondents for a design for a household medical cabinet. Tbe accompanying sketches, wbich exhibit in Fig. 1 the front elevation of a useful form of cabinet that may be used for tbe storage of medicines, etc.; and in Fig. 2 the side elevation may be of assistance to some who are contemplating the construction of such an article. The cabinet is supported on iron brackets, as shown in Fig. 2, but it may be placed on a sbelf in a recess, or any convenient position. It may be turned to account for other purposes than that of a receptacle for medicines, and may be used, for example, as a small book-case, or for china, glass, etc. The construction is simple, and, if it be tbougbt desirable, it is easy to render it far more ornamental in appearance.

The frame is of deal $\frac{3}{4}$ inch thick, and measuring 29 inches by 19 by 7 inches. The top projects 1 inch (except at back), to form, with 2-inch "ogee" moulding, a cornice. An "ovolo" moulding, $\frac{3}{4}$ inch, runs round the base. The drawer is $2\frac{1}{2}$ inches deep (to 3 inches), with a facing $\frac{1}{4}$ inch cut out with a fret-saw to form a panel. Above the drawer, the bottom of cabinet proper has its front rounded edge projecting at ends, to meet the balf-round moulding across the sides.

This piece slides into rebates $\frac{1}{4}$ inch deep; but rebates for shelves run *from the back* only to within 1 inch of the front, allowing the door to fit in against shelves. Tbe latter also permit this back ($\frac{1}{4}$ inch thick) to be set in against them. They are made of $\frac{1}{2}$ inch stuff. The door is mortised and rebated for glass or any desired panel. The panels at sides are made with half-round moulding, and the top is surmounted by a piece of fret-work, which opens for the face of an American spring alarum clock.

The whole may be stained or finished in natural wood.

FIG. 1. FIG. 2.



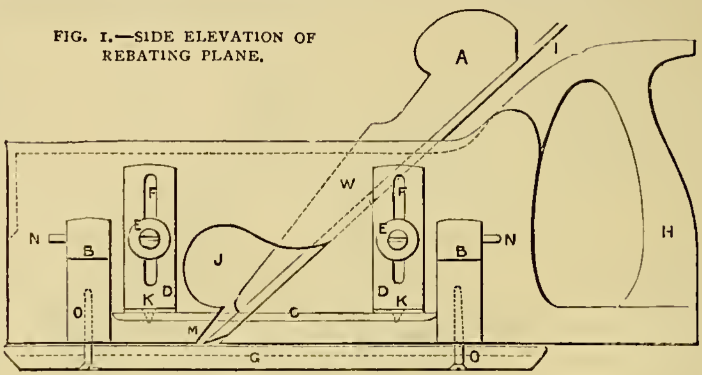
HOUSEHOLD MEDICAL CABINET WITH CLOCK.
Fig. 1.—Front Elevation. Fig. 2.—Side Elevation.
Scale, $\frac{1}{8}$ inch to 1 inch.

XXIII.—HOW I MADE MY REBATING PLANE.

[*From J. W. S. ORKNEY.*]

I INTEND in this short paper to describe how I made my rebating plane, a very useful tool for running out grooves or rebates for window glass and numerous other jobs. The description of home-made tools, accompanied by explanatory working drawings in the pages of AMATEUR WORK, is of great importance and assistance to amateur workmen, and, for my part, I shall always be ready to give such information as I can with reference to any tools that I may make, because it may be of use to some of my brother amateurs. But I am wandering away from the subject of my remarks, and as time and space is limited, I will proceed at once how to set to work to make the above tool.

FIG. 1.—SIDE ELEVATION OF REBATING PLANE.



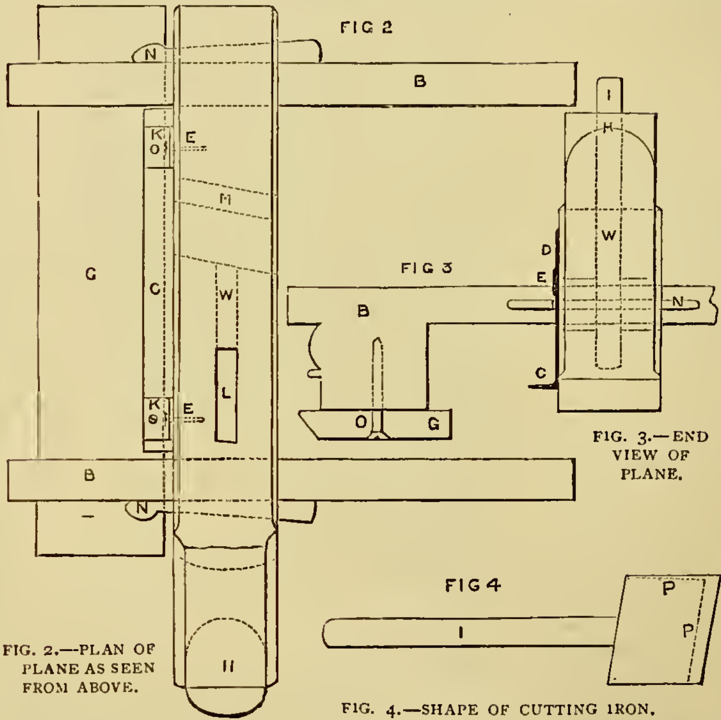


FIG. 2.—PLAN OF PLANE AS SEEN FROM ABOVE.

FIG. 3.—END VIEW OF PLANE.

FIG. 4.—SHAPE OF CUTTING IRON.

First, secure a piece of beech 11 inches long, 3¼ inches wide, and 5 inches at the handle by 1⅜ inches thick. Dress one side out of a twist, and when this has been done square the edge that is to be the sole. Next dress the other side, and edge and end. At the end that is 5 inches broad mark out the handle, as shown at H, Fig. 1. The handle, as shown at H, Fig. 2, is made a little thinner than the body, there will be no trouble in determining the sizes of the different parts, as the drawings are all one-third size; that is to say, on the scale of 4 inches to the foot.

Next mortise a hole for the cutting iron and wedge, as shown at W, Fig. 1. The mouth is made in a screw form, as shown by the dotted lines in Fig. 2, at M. Make a hole for the shavings to come out of, as shown at J. Next mortise two holes about ¾ inch square, and round the upper side of the holes a little, as shown at B, Fig. 1. Make two small mortises in two sides of the holes, as shown at N, Fig. 1. These small mortises are for two little wedges to keep the arms of planes in any required position, and at any distance from the body of the plane.

Next get two pieces for the arms, and dress them to shape, shown at B, Fig. 3. These arms are made to fit the two ¾ inch holes before mentioned. Having proceeded thus far, get a piece of wood for the guide face, and dress and fix it on with two screw nails, as is shown at O in Figs. 1 and 3. G shows the guide face fixed on to the arms in Figs. 1, 2, and 3.

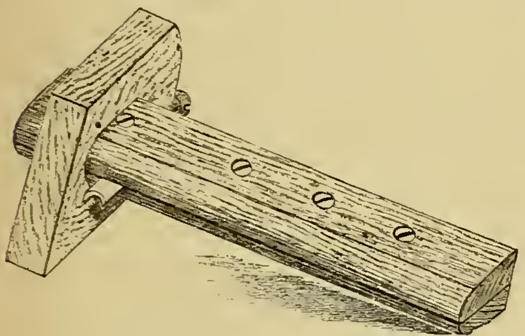
Supposing we have got the guide and arms finished, we must now try to construct some kind of gauge for the depth of rebate. I made mine of a bit of iron 5 inches long, ¾ inch wide, and ⅛ inch thick; I took a piece of 1 inch hoop, and then I cut two slides in it as at F, Fig. 1. I then bent the end of it in L shape, as is seen at C, Fig. 3. Drill a hole through the L piece and the bit of iron, then rivet the L piece to the bit of iron, as is shown at K, Figs. 1 and 2; D is the form of a piece of hoop with slide; E shows a washer and small screw-nail for fixing the gauge to any depth. Fig. 4 shows the shape of cutting iron.

XXIV.—A BEAD SCRATCH.

[*From L. D. I.*]

THIS is only an adaptation of the Scratch shown on page 305, Vol. III., of AMATEUR WORK. The head is a separate piece of wood fitting tightly on the body of two thin strips screwed together. The screws are slackened, and

a thin piece of steel is inserted between—the edge of the steel being formed the reverse of the moulding required. The screws are then tightened and the head put on, the same distance from the steel tooth as the beading is to be from the edge of the work. The head is kept in its place by a screw—with the point filed flat, so that it does not enter into the body—seen at the right hand side of the bead.



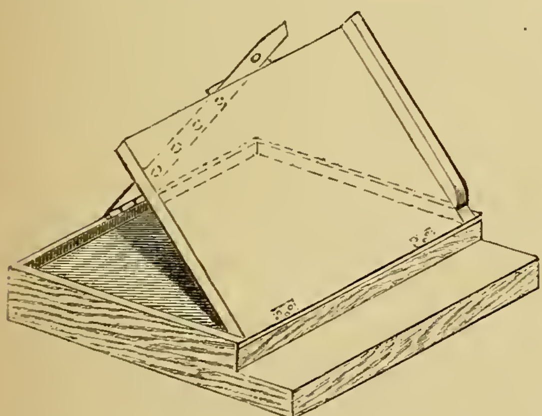
A BEAD SCRATCH.

XXV.—SHUTING BOARD.

[*From L. D. I.*]

I HAVE often experienced a difficulty in getting the exact bevel in the sides of boxes of a polygon shape. If others have been in a similar position the accompanying sketch may be of as much service to them as the object it represents has been to me. No explanation is necessary, I believe.

The side to be bevelled is placed on the raised, or lid-like board, and held firmly against the ridge on the right-hand side.



SHUTING BOARD.

The plane is used as with the ordinary shuting board. The board is hinged as shown, and held in a slanting position by a rack at the back, with holes into which a pin in the edge of the board enters. A bevel of any angle may be obtained by raising or lowering the board on the rack. The rack may be marked. For example: Our box is a hexagon, therefore we want an angle of 120°, and a bevel of 60°. We set the board right at once and mark it, and we can always get an angle of 60° by placing the pin in that hole of the rack. In the same way we find the angles of all other polygons and mark them. I give no details or measurements, the sketch shows the idea, and the idea, if practical, shows the rest.

NOTES ON NOVELTIES.

By THE EDITOR.

39. ROGERS' "ART OF WOOD CARVING." 40. MATHIESON AND SON'S TOOLS FOR BRASS REPOUSSE WORK. 41. GAWTHORP'S "HINTS ON REPOUSSE WORK." 42. CRAIG'S "GOLD PAINT." 43. "ELECTRIC LIGHTING." 44. "A PHOTOGRAPH, AND HOW TO TAKE IT." 45. "THE MODERNISED TEMPLETON." 46. "ARCHITECTURAL MODELLING." 47. "THE ARTISTS' MANUAL OF PIGMENTS."

39. ROGERS' "ART OF WOOD CARVING."—Not long ago a correspondent was kind enough to call attention to the fact that amateur wood carvers could always procure patterns for copying, either on paper or in the wood itself, from Mr. George Alfred Rogers, 29, *Maddox Street*, *Oxford Street*, *W.*, artist in wood to the Queen, and Professor of the Crystal Palace Schools of Art. Having seen Mr. Rogers' designs and specimens of his handiwork, I can testify to the excellence of both, and recommend them to my readers. I may further suggest that those who wish to know more about them with the least possible trouble, may do so by obtaining from Mr. Rogers, or from his publishers, Messrs. Virtue and Co., *Ivy Lane*, *Paternoster Row*, *London*, *E.C.*, his work, entitled "The Art of Wood Carving," which is now in the eleventh edition, and costs 1s. This nice little book is replete with practical hints to amateurs, containing, as it does, full instructions and advice respecting requisites and useful accessories for the prosecution of the art, on the choice of woods, on the work to be done, and how to do it; and, finally, on its completion by staining, oiling, varnishing, and polishing. Twenty-eight illustrations are given, which will be useful to all wood carvers as designs, and suggestive of the application of the work in a variety of ways. It is desirable to add that Mr. Rogers has been awarded seven medals at various exhibitions for the excellence of his wood carvings, and that he will send, on application, a catalogue of his full-size working drawings, with prices, and lists of models to be lent on hire.

40. *Mathieson and Son's Tools for Brass Repoussé Work.*—Hammer work in sheet brass is an employment that is now being much looked after by amateurs, and as soon as some of the serial papers that are now appearing in the Magazine are completed, I have much pleasure in saying that instructions in this desirable and pleasing branch of decorative art will be commenced by Mr. H. C. Standage. Meanwhile, I have much pleasure in calling attention to the tools and appliances manufactured for the execution of brass Repoussé Work by Messrs. Alexander Mathieson and Son, 8, *Church Street*, *Liverpool*, which are of the first quality, and comprise everything that is necessary for carrying out the work. Of the specimens of their manufacture, which Messrs. Mathieson and Son have submitted to me for examination, I can speak

in terms of the highest commendation as regards make and finish, and their utility for the various purposes for which they are constructed. I can strongly recommend their mallets, both of ox hide and of box; their hammers, some of which are specially constructed for the work, and their tracers, punchers, and bead, high relief, and matting tools. The last-named tools range in price from 6d. to 1s. 6d. each, steel hammers, 1s. 6d. each; steel hammers of the coil make, 2s. each; boxwood mallets, round and flat-faced, 10d. each; ox hide mallets, 2s. each. For prices of material and other tools and appliances, I must refer my readers to Messrs. Mathieson and Son's price list, which will be sent on application. I may add that selected sets of tools are supplied at 7s. 6d., 10s. 6d., 15s., and 21s. 6d. per set, and a useful book of instructions for 6d. Moreover, those who have a taste for leather work—which is an effective style of ornamentation, bearing a close imitation to wood carving, and desirable for persons who cannot, or do not care to handle carving tools—will be glad to know that Messrs. Mathieson and Son supply tools, and every requisite for its execution at moderate prices.

41. *Gawthorp's* "*Hints on Repoussé Work.*"—That Repoussé Work is very much to the front at the present time is shown by the fact that I am called upon to notice at one and the same time, tools, appliances, and instructions on this subject, emanating from and manufactured by two different dealers. Before me now lies a quaint-looking little pamphlet of sixteen pages, printed, illustrated, and got up in the style of a hundred and fifty years ago, and issued by Mr. T. J. Gawthorp, 16, *Long Acre*, *London*, *W.C.*, and lately of 16, *Olde London Street*, *International Inventions Exhibition* (1885), and at which Exhibition Mr. Gawthorp was awarded a prize medal. The pamphlet tells us what "*The Queen*"—not Her Majesty—whom may God preserve for many a long year yet in the possession of a United Kingdom and ever-extending Empire—says about Repoussé Work and Master Gawthorp's connection with it, and gives notes on the antiquity of the work itself, with hints on the tools and materials required, the method of working, and the cost of apparatus. The instructions are thoroughly practical, and two or three designs are given of considerable beauty and highly appropriate for the work. The instruction book is supplied by itself at 1s., or free of cost with materials to the value of 2s. 6d. Mr. Gawthorp supplies a prepared cement in tins at 1s., which will be found to be a better material than pitch on which to hammer the brass, and cement bowls or blocks from 2s. 6d. to 5s. 6d. Amateurs who desire to make a good beginning and excel in the work will be glad to know that Mr. Gawthorp gives lessons of one hour, by appointment, for 5s. per lesson, or series of three and six lessons at 12s. 6d. and 21s. respectively.

42. *Craig's* "*Gold Paint.*"—I had occasion some time ago to notice in these pages the excellent "Transfer Gold Leaf," for gilding, supplied by Mr. Walter T. Craig, *Miller Street*, *Wick*, *N.B.*, which has been used with the best effect by many amateurs, who bear testimony to its efficiency and economy. Mr. Craig has now produced a nice japanned case measuring 6⅛ inches by 2⅜ inches by 1⅛ inches, containing all the requisites for gold painting, which will be sent, carriage free, to any part of the United Kingdom on receipt of a postal order for 2s. 6d. "This case," Mr. Craig remarks, "will be found superior in quality and equal in quantity to cases sold at four times the money, and is offered at this low price for the purpose of introducing the goods to the public." He further suggests in a letter to myself, that the best test, perhaps, of its superiority in quantity and quality to other gold paints sold at higher prices would be to empty out the gold on a sheet of paper alongside of any other sold, and then to note the difference in each. The case I should say contains a very large bottle of gold paint—that is to say, a bottle measuring 1¾ inch by 1¾ inch by ¾ inch, exclusive of the neck, which, it will be clear to all, must contain a considerable quantity of paint, a bottle of enamel medium of the same size, for protecting the gold paint when laid on, a small saucer 2⅝ inches in diameter, coated externally with fine wicker work, for containing the gold during the process of painting, and a camel-hair pencil in tin tube. The gold paint has been prepared to resist every influence likely to cause its oxidation, or, in other words, to turn black, which is a notable defect in gold paints generally; it can be applied to almost any material without any preparation whatever; and by reason of the quantity supplied it is certainly economical, as the contents of a single bottle is sufficient to cover a very large area of surface. To the brilliancy and beauty of the paint I can testify, and to its general excellence and economy also. I believe further that it will, as Mr. Craig says, fully stand the test of time with regard to its power of resisting the blackening action of the oxygen in the air; but as I am unable to look ahead or see further into a milestone than any other of my brother mortals, I cannot certify this, at all events for another year or two. I can only say I have been disappointed in the results yielded by gold paints generally when subjected to the test of time, and in this I think amateurs generally will be disposed to agree with me.

43. "*Electric Lighting.*"—This is the title of a pamphlet issued by Messrs. Swete and Main, Electrical Engineers and Electricians, *Baskerville Works*, *Orbel Street*, *Battersea*, *London*, *S.W.*, purporting to be "A Few Remarks upon the Cost and Maintenance of the Incandescent System of Electric Lighting, as Applied to House, Office, and Workshop"; and in these words, perhaps, the best description of the pamphlet is found. Its price is 6d., and it is well worth the money, as it supplies much useful information on the prime motor for the generation of the electricity necessary to produce the light, the requisite plant, the means of lighting, and the cost. To this is appended a price list of the dynamic machines, incandescent lamps, lamp-holders, switches, culverts, brackets, electroliens, pendants, standards, measuring instruments, and Thame's portable bichromate batteries, manufactured and supplied by Messrs. Swete and Main. All who are interested in electric lighting will find this pamphlet useful.

44. "*A Photograph, and How to Take It.*"—If those who are interested in electric lighting are to be counted by tens, surely it may be said that the votaries of photography are to be numbered by hundreds, and to many of these the pamphlet now under consideration, entitled "A Photograph, and How to Take It," written by "One who Knows," and

edited by Mr. A. A. Wood, F.C.S., will prove a useful and welcome *vade mecum.* No price is named, but if I may judge from pamphlets advertised in the back page of wrapper, namely, "Magic Lanterns: How Made and How Used," and "Hints on Telescopes," both sold at 1s., and published by the same firms, namely, Mr. E. G. Wood, 74, *Cheapside, E.C.*, and Messrs. Horne, Thornthwaite, and Wood, 416, *Strand, W.C.*, I am inclined to think that the price of "A Photograph, and How to Take It," must also be 1s. The pamphlet itself contains all necessary instructions for the prosecution of dry plate photography, put as briefly as possible, and is followed by a descriptive catalogue of the photographic apparatus and chemicals manufactured and sold by the two firms just mentioned. To amateur photographers the combined pamphlet and catalogue cannot fail to be of use.

45. "*The Modernised Templeton.*"—Messrs. Crosby Lockwood and Co. send me a copy of their entirely new edition of "The Practical Mechanic's Workshop Companion, comprising a Great Variety of the Most Useful Rules and Formulæ in Mechanical Science; with Numerous Tables of Practical Data and Calculated Results for Facilitating Mechanical Operations." This work was originally written by Mr. William Templeton, but the present edition has been revised, modernised, and considerably enlarged by Mr. Walter S. Hutton, C.E., author of "The Works' Manager's Handbook of Modern Rules, Tables, and Data," so that the publishers rightly style it the modernised "Templeton." The book itself, in its new form, is a compact foolscap 8vo volume of 484 closely but clearly printed pages, strongly bound in leather, and is supplied for 6s., which, considering the vast amount of information that is contained in it, is remarkably cheap. To enumerate all the subjects bearing on mathematical and mechanical science, and the various tables that are contained in it, is simply impossible, seeing that the "Contents" alone take up four pages. It will be enough to say, that in the elementary and educational portion of the work, every workman will find information bearing on and helpful to him in the exercise of his trade; and that this has been brought down to the latest date, and is most carefully revised and modernised. Among the new and additional matter that has been provided by Mr. Hutton will be found information on air, gas, water, heat, and steam, the method of testing steam-engines and boilers, particulars of turbines and other water motors, the strength and weight of materials, rules for tooth and wheel gearing; with much valuable miscellaneous information with respect to engines, boilers, chimneys, etc., and a great variety of practical rules, tables, and data. The work is illustrated with 250 diagrams, etc., and is furnished with an excellent index. In reproducing Templeton's book in its present form, Mr. Hutton and the publishers have done good service to all workmen, both professional and amateur, in providing them with the means of obtaining at small cost a mass of information, mathematical, mechanical, and practical, that will prove of the highest importance to them in the prosecution of their various callings and hobbies.

46. "*Architectural Modelling.*"—This is a volume of Weale's Rudimentary, Scientific, and Educational Series, which will prove an inexhaustible source of pleasurable work to amateurs who have a fancy, as I know many have, for modelling of an architectural character. The actual title of the book itself is "The Art of Architectural Modelling in Paper," by T. A. Richardson, architect. Its price is 1s. 6d. The material for the work is paper, and it is really surprising to find what may be done with a substance that is at once so strong in itself and yet so easily destroyed. After a few remarks on the art itself by way of introduction, the author describes the materials that are required, and the instruments that are necessary, and then proceeds to describe the method to be followed in making a model from commencement to finish. He further gives some hints on landscape gardening, also in modelling, in which cork is brought into requisition as a material for the imitation of flower beds, etc., and concludes with a glossary, in which several architectural terms are explained, and the mode of dealing with the various details which they express. The book, which consists of 106 pages, including titling, is illustrated with several well-executed engravings which will prove of great assistance to the modeller. All amateurs who have a liking for work of this description should provide themselves with this brief but sufficient exposition of the art of modelling in paper which sets forth all that it is needful to know on the subject, in the clearest manner and the fewest possible words. It is published by Messrs. Crosby Lockwood and Company, 7, *Stationers' Hall Court, E.C.*

47. "*The Artists' Manual of Pigments.*"—This is chiefly a reproduction in a more handy and far prettier forms of "The Artists' Table of Pigments," by Mr. H. C. Standage, one of the contributors to "ours," which I noticed at some length in Vol. II., page 590, of this Magazine, and to which I must refer my readers for a general description of the contents, purpose, etc., of Chapters I. to VI., in which I may say briefly are set forth the names of the various white, green, blue, yellow, red, brown, and black pigments in use for artistic and decorative purposes, with notes on their chemical names and composition, artistic qualities, conditions of permanency and non-permanency, general adulterations, tests for purity and nature of adulterations, and other desirable information with regard to them. In the present edition, which forms a beautifully got-up little volume, published by Messrs. Crosby Lockwood and Company, 7, *Stationers' Hall Court, Ludgate Hill, E.C.*—I do not know the price—Mr. Standage has given other six chapters on the chemical reactions occurring between two or more pigments, between pigment and vehicle, etc.; colour names and definitions; a table of mixtures to produce blues, buffs, browns, greens, greys, purples, and maroons; the artistic qualities of pigment used in portrait, flower, and marine painting in water colours; and the artistic qualities of colours used in landscape painting in oils; with examples of questions set at the South Kensington School of Art Examinations in Painting. A short but sufficient index is added. To all painters who desire to become fully acquainted with the nature and composition of the pigments that they use, and their influence one on the other in combination, this book will prove most helpful—in fact, it is not too much to say that it is absolutely necessary to them.

AMATEURS IN COUNCIL.

*** For Instructions to Correspondents, see page 44 of this Volume.*

The Reflecting Telescope.

*** Errata.—In page 377, at end of inscriptions to Figs. 45, 47, and 49, for "Fig. 6," "Fig. 8," "Fig. 10," read "Fig. 44," "Fig. 46," "Fig. 48," respectively. And Figs. 45, 47, and 49 have accidentally been inverted.

Henry's Patent Sash Line Fastener.

*** The following remarks of W. H. F., a builder, on my notice of Henry's Patent Sash Line Fastener, in "Notes on Novelties," page 327 of this Volume, and Lieut.-Col.Henry's reply thereto, will be useful to all who are interested in this subject.

W. H. F. writes:—"Having been a subscriber from the first to your admirable Journal, and having seen some good things therein, I wish to offer a few criticisms ou your article, No. 30, iu 'Notes on Novelties,' on Henry's Sash Line Fastener, as if the patent is put on the sash as explained, the whole thing will have to be goue through as in the old way. Not one sash cord in a hundred breaks where it is nailed, nearly all go just where the cord rests on the pulley. You say, 'Attach the sash line to the fastener, and put the sash back in its proper position, and pass the other eud of the rope over the pulley and fasten to the weight.' This cannot be doue, especially where the weights are large, as some are 3 inches or 4 inches above the pocket piece. Then you advise to take the portion off the pocket piece that is behind the parting bead, which should not be done in any case, as this is what holds it in, and prevents it from warping; also, in the best windows the pocket is cut out of the centre of pulley. Still I fail to see the advantage in them, only saviug nails, and the best sashes are bored down with a bit to receive the sash cord, ouly a knot being required. You say that a considerable saviug will be effected by it. I fail to see this, as any ordinary joiuer will put all four cords in a window in about an hour. You say they are 8¾ inches long: this is too short for any sash, as if properly hnng, the sash cord should be fastened in the centre of the height of the sash. Also, great care is required in putting sash cords in so that the cords are neither too long nor too short, and that the cord is properly stretched before being put in. Having been in the trade for above twenty years, I write just so that some may not be misled, but not in any way to run the article down which you have so ably written upon it."

Before replying myself to the strictures which W. H. F. very properly aud aptly makes from his point of view on my critique, I thought it better to give Lieut.-Col. Henry an opportunity of replying direct to my correspondent. He has done so, and as his answer is possessed of far greater authority thau anything I might say could be, and will be of use in correcting any erroneous ideas that may have arisen in the minds of readers regarding his sash fastener, I give a copy of his letter to W. H. F. here:—

Lieut.-Col. Henry writes:—"The Editor of Amateur Work has sent me your letter with remarks ou my Sash Line Fastener. I am always glad to hear the criticisms of practical persons like yourself, and will endeavour to meet them by explaining as far as possible on paper, and with the aid of the diagram what may make my invention appear more useful. Your first remark is perfectly true. Every cord breaks from friction over the pulley, but no matter where it breaks, in the old plan you must take out the sash and parting beadings, and both sashes when cord of top sash is broken. I always fasten the new rope first to the weight before cutting off the exact length, the cord having been passed down over pulley in the usual way with a mouse. Then measure length of cord required, leaving plenty of space below weight for stretching of cord (which, as you say, should be first stretched); then fasten end of cord that would in the old

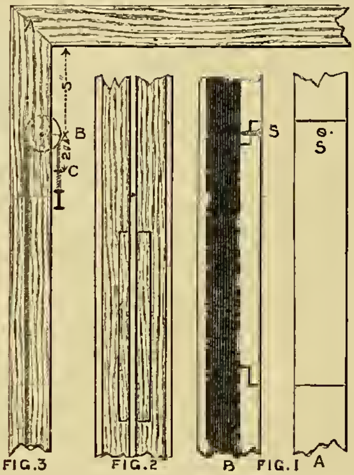


FIG. 1.—ATTACHMENT OF POCKET BY SCREW. FIG. 2.—MODE OF CUTTING PARTING BEAD PASSING OVER POCKET. FIG. 3.—FRAMEWORK OF WINDOW, SHOWING REQUISITE DISTANCE OF PULLEY AND SCREW FROM TOP.

plan be nailed to sash to the fastener by the three pinch screws. Having done that, slip fastener and attached rope down groove of sash, and screw down to top bar of sash. Of course, the first time a fastener is put in it must be made a nice fit in the existing groove, and the short arm of fastener recessed into the top bar. After that is once done, whenever a rope breaks, no matter where, all you have to do is to unscrew the fastener, draw it out, then take old rope off weight, and replace rope as first explained. You say you cannot fasten cord to large weights as they are 4 inches above the pocket piece. The openiug of pocket piece should, in my humble opiuion, be always at least 6 inches higher than the weight when it has fallen down after a rope breaks, otherwise how are you to pass rope through eye of weight to knot. With the fasteners you can fix the rope first to the weight, a great advantage, as the rope can then be easily cut to exact length, not wasting any. Several carpenters who have put them in say they fiud this a great advantage. Cutting off ¼ inch from one side of pocket piece cannot possibly make the pocket piece warp. Generally they fit so tight that no fastening is required. In fact, in this house, and two or three others in this part of London (S.W. postal district), where the fasteners have been fixed, the pocket pieces are put in without any screw. Thus in Fig. 1, in which A is elevation, and B section, S a small brass screw through top lap, holds the pocket piece quite firm. Where the pocket piece is held in place by the parting bead between the sashes, which I find is very seldom the case, the only plan is to cut the parting bead in two, leaving upper portion as a fixture, and only move lower or smaller portion to take out pocket piece, as shown in Fig. 2. There is a house in the London square in which I live done like that, and the carpenter tells me it is very unusual and only in old houses. Once fitted, five minutes suffices to put in a cord iustea l of half au hour; besides, if the back sash cord is broken, in the old plan both sashes must be moved, parting beads, etc., and no carpenter will do this under an hour, to say nothing of the mess, discomfort, etc., particularly in wiuter, in having your sashes out. Carpenters always (generally, not always—Ed.) put in new cords all round when one is broken; that is, if one cord is broken, the other one is always taken out and a new one put in—a great waste of time aud cord. Again, 8¾ inches is quite long enough for ordinary windows. All you require is to have the first nail or screw holdiug rope 2 inches below centre of pulley wben sash is up. This is shown in Fig. 3, in which A is frame of window, B the pulley 5 inches below frame, and C finger screw or nail 2 inches below pulley. This distance between pulley and screw will throw any sash clean up to top of frame. Fastening the rope lower down is waste of rope and of no use. I hope I have made myself clear, but it is hard to do so on paper. Some of the largest builders in London have seen my fastener, and find no fault in its construction, but I am very much obliged to you for your practical remarks."

Photo-Zincography.

J.H.B. (*Penzance*).—I have given you the best possible answer to your query by handing your letter to Messrs. Pornot and Dougal, Photo-zincographers, 1, *Maclean's Buildings, New Inn Square, Fleet Street, E.C.*, from whom, long before this meets your eye, you will have received a communication on the snbject.

Wheels for Electric Clock.

A. W. writes:—"I am making an electric clock, and got my wheels cut by Mr. Franklin, 1, *Garnault Place, Clerkenwell, E.C.* He also does rackwork, bevel wheels, spur wheels, etc., up to about 18 inches.

Tricks of the Stage.

Stage Manager.—A paper shall be given on what you term "tricks of the stage" at no distant date.

Wires for Dulcimer.

F. W. S. (*Peckham*).—Referring to my paper on the Dulcimer, Vol. II., page 121 (or Part 14), I find that the number of the wires are correct. I have never used any other. The half notes (those with two wires) require tuning until they give out the half tone to the two natural notes between which they are situated, that is, sharp to the one below, and flat to the one above it, on the right hand side of the dulcimer of course; you cannot tune the half notes for both sides of the bridge.—C. G.

Electric Light for Shop.

Ohio.—You will save very little expense by using jam jars as outer cells for an electric light battery. Apart from this, there are few of such jars suitable; even the 6 lb. size is not large enough. I advise you to communicate with Mr. E. A. Lee, 76a, *High Holborn*, and ask him to furnish you with an estimate for lighting your shop by means of his battery.—G. E.

Small Lathe on Sewing Machine Stand.

Mad Jack.—The stand will carry your 2½ inch lathe comfortably, and form a very convenient work-table. The independent fly-wheel is also an advantage, but it is probably too light. This, however, may be remedied by casting a leaden ring, and attaching it on the outside of rim, thus enlarging the fly-wheel in diameter. A wooden rim could be fixed on the side of the 12 inch wheel, and speeded to suit the cone pulley on mandrel. This would be better than using the 10 inch wheel which, I presume, has but one speed groove.—Olla Podrida.

Noisy Clock.

Clericus.—You say, "I thought of correcting the noisy clock by putting a small piece of rubber on the pin that stops the striking train, that is, the pin on the wheel next to the fly," and ask, "Would that do?" Try it by all means. The experiment won't cost much, and the clock be none the worse for the attempt. From your description I am inclined to think that it would be effective.—Olla Podrida.

Gilding with Gold Leaf.

Only an Amateur.—If you will refer to the papers entitled "The Art and Mystery of Gilding," in Parts 25 and 27 of this Magazine, you will find precise instructions on the mode of preparing the ground, and applying the leaf. For gold leaf, write to Mr. Walter T. Craig, *Wick, N.B.*, whose "Transfer Gold Leaf" is the best I know for amateurs' use.

Papers on Boot Making.

W. R.—The papers entitled "Boots and Shoes: How to Make and Mend Them," appeared in Parts 1, 2, 3, 4, 7, 9, 10, and 21.

Recipes from Old Books, etc.

Mad Jack.—I am obliged to you for your contributions, but I wish to save you the trouble of copying recipes from old books, and sending them for insertion in "Amateurs in Council." If any question is asked that can be answered by means of an old recipe, then it is more desirable to send the recipe, but the space in this Magazine has too great a demand on it to permit me to appropriate it to recipes copied from other sources, without very good reason. I am referring now to the recipes you send for casting medals and figures in basso-relievo, both of which are well known.

Recipe for Ebonizing Wood.

A. E. M.—You say that you have carefully followed the directions given in page 178 of this Volume, but that the result has been a fine dark slate blue which stains everything put on the shelves. Your liquors must be wrong, probably too weak. Get them from Wooley, Chemist, *Market Street, Manchester*, or any cabinet manufacturer. The latter, I believe, uses them mixed together for French polishing afterwards. If properly rubbed to a polish with a dry rubber, the stain will not come off to harm anything, but to make a perfect job of it, it should be French polished as directed in the article referred to. If you had not, as you say, "carefully followed the recipe," I would have said rub the staining till it polishes, and apply some more coats, as after the first coat of both liquors the shade of colour inclines to a deep blue black.—C. T. S.

Slide Valve and Ports.

N. E. Signalman.—When the valve is in the middle of its stroke it should cover *both* ports. This amount of cover, technically termed "lap," may be determined from the travel of the valve. By giving "lap" to the valve, it is enabled to cut off the steam before the completion of the stroke. It would be convenient to make your valve cut off at three-quarters stroke, *i.e.*, when the piston has travelled through three-quarters of its stroke the valve will close the port. To do this the valve should be made to overlap each port by an amount equal to one-quarter of its own travel when in the middle position. For instance, supposing the travel of your valve is 1 inch, then the valve when placed at half stroke should equally cover or overlap each steam port by ¼ inch, so that in moving either way it would have to travel that amount before the port began to open. You will have to make a new valve. If the directions given are adhered to, your engine will work all right linked up or otherwise. I hope the foregoing will make it clear to you. If not I shall be happy to give further assistance.—Olla Podrida.

Clock Cleaning.

A. B. C.—No apology is necessary. Why didn't you come forward before. By so doing the writer would have been saved considerable time and trouble, and what is of more importance, Amateur Work been benefited to a greater extent than my limited knowledge on the subject could compass. I sincerely hope that you will relieve me of a task which, to an amateur in the subject is a most irksome one. I am obliged to you for the remarks on my papers *re* Clock Cleaning; also for the courteous tone in which they are made, and freely place the matter in your hands, feeling sure that the subject will receive far more justice at the hands of a professional than in those of an amateur like Olla Podrida.

Bookbinding, Height of Beating Stone Box.

Indebted.—Does it not strike you that the best height for your beating stone should be the most convenient height to yourself? If you are a short man, the beating stone should be low, if tall higher. But if this is not enough for you, tell me your height, and I will tell you the height for stone.—Author of "Bookbinding for Amateurs."

Interchangeable Tanks for Self-Acting Fountains.

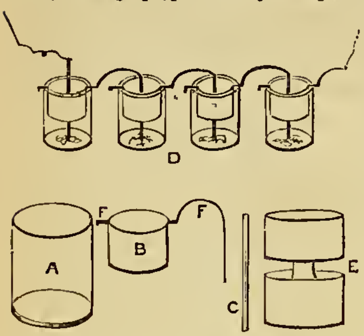
Racavar.—In using interchangeable tanks for working self-acting fountains, it is quite impossible for the lower one to discharge the *whole* contents of the upper one, being both of the same size, as a considerable volume is lost by the act of compressing the air in the lower tank, that is to say, before the water in the upper tank can rise to so great a height as six feet above aquarium, a large quantity of water has had to enter the lower tank to compress the air to a sufficient tension. You should not, however, lose so much as half; some leakage must be the cause of your losing about one-fourth of the volume. No arrangement of cocks will obviate this natural difficulty. It would be interesting to learn how you, as an amateur, have succeeded in making an air-tight vessel to hold eight gallons, to withstand a pressure of a column of water 15 feet high; what metal, and how joined? You could, of course, make the fountain play a much longer time by reducing the size of the orifice of jet at top.—D. B.

Cabaret Battery.

A. B. C.—You broke your zincs. I am not at all astonished at that, if you tried to bend them. If you wanted them *very* thick (as indeed it was advisable) you ought to have cast them, which is a very easy thing to do. However, I do not think it matters very much if they are in two pieces. As to the rapid melting of the sulphate, it is in proportion with the power of your battery; as a matter of course, the more sulphate and zinc you spend, the more powerful your battery is. I could not tell you exactly how much sulphate of copper I spend. I have four jars (a little larger than yours), and I refill them about every month. Notwithstanding what I said in describing the battery, it is not strictly necessary that the tubes should always be full. You must add sulphate of copper when the blue tint gets paler or lower in the jar. Have you ascertained that your zincs are made of pure metal, for this is rather important? I will tell you the way how to proceed to make it sure. You wet a clean piece of zinc with a drop or two of sulphuric acid, then with a little water, and put on it a small lump of iodide of potassium; if the zinc be pure, it will turn black; if not pure, yellowish. One more word, you must expect to spend a great amount of electricity, if you consider that, in driving the electric clock, the bobbin gets, so to say, full and empty, once every second. The Cabaret battery is *not* perfection; but I do not think there is a better one for working a clock of this description.—Prof. L. Marissiaux.

Battery for Electric Bell, Clock, or Telegraph.

RACAVAR writes:—"The following is a simple, durable, and inexpensive method of fitting up a battery for electric bell, clock, or telegraph, particularly in England



BATTERY FOR ELECTRIC BELL, ETC.

A, Glass Jar; B, Zinc, half height of Jar; C, Copper Strip for first Jar; D, Battery in action; E, Glass vessel specially made for such Battery; F F, Copper Strips attached to Zinc to hang on to Glass Jar.

where sulphate of copper is cheap. Take six, eight, or any number of glass or other jars—glass tumblers will do as well, and glass is to be preferred in order to *see* the effect—and an equal number of circular zincs to size (amalgamated) having a small strip of copper at one side, and a longer strip, say nine inches, at the opposite side (*vide* diagrams). The zinc is to be equal in height to half the vessel, *i.e.*, glass or other jar. Place the jars in any convenient or desirable order, then hang the zincs on to the jars by the strips of copper, and bend the longer end into the next jar until end of strip touches the bottom of jar—put plenty of sulphate of copper at bottom of each jar—fill with water, and your battery is ready after, say four or five days, according to the number of jars. The liquid blue, caused by the solution of the sulphate of copper, will only rise as far as the zinc, and remain there showing that the battery is in action. In the first jar put a copper strip for a terminal. This battery will at a stretch work without looking after for about three months when for bell use. Any further information for this or other simple cheap batteries, I shall be happy to supply, with the Editor's kind consent, through 'Amateurs in Council.'"

Cold Soldering and Brazing.

A RAILWAY MAN.—The answer to your question should be both yes and no! Yes; metals can be made to unite, and joints can be made by cold chemical means. No; metals cannot be so *closely* united without the agency of heat as with it, nor can the joints of a model engine boiler be *safely* brazed in any other way than by fire. I hope to show in an article on the subject what can be done in cold soldering, etc.—G. E.

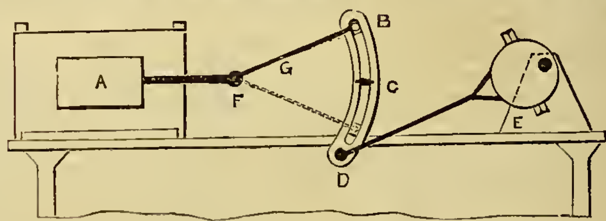
Repoussé Work.

H. B. (*Torrington*).—The instructions you refer to are necessarily brief. The pattern in repoussé, or beaten brass work, is in relief, and stands above the background, with which its bright smooth surface offers a suitable contrast. The depth to which the background can be beaten down depends mainly on the size of the work. You cannot, for example, give such high relief to the stalk of a pear as you can to the broad space occupied by the fruit itself. You can try hammering down a design, but I do not think you will be satisfied with the result. I have a series of articles on repoussé work awaiting publication; but I must complete some of the series of continuous papers now running before I can produce them. Meanwhile send sixpence to Messrs. Alexander Mathieson and Son, Tool Manufacturers, 8, *Church Street, Liverpool*, for their instruction book, which is to the point, and will be helpful to you.

INFORMATION SUPPLIED.

Reversing Horizontal Engine.

TWIST DRILL writes in reply to MODEL ENGINE, page 353:—"I enclose a sketch of an idea for reversing with one eccentric. A



REVERSING GEAR FOR MODEL ENGINE.

is the valve chest, F the end of valve rod, G rod connecting it with link B, moving on a pivot at C, and worked by eccentric rod hinged at D. On lowering G to position shown by dotted lines, the engine will be reversed."

A Gold, Silver, or Copper Colour on Wood.

MAD JACK writes:—"Take crystal, and beat it in a mortar to powder, then grind it on a marble with clean water, and put it into a clean new pot; warm it, and add to it a little glue. With this strike or paint over your wood. When dry, take a piece of gold, silver, or copper, and rub it over therewith, and you will have the colour of any one of those metals upon the wood, which you may afterwards polish." [Have you tried this? It looks very much like a cutting from some old book of recipes, most of which were impracticable. It is desirable that recipes sent for insertion in AMATEUR WORK should be recipes which have been tested and found reliable by those who send them. I shall be glad to have your experience with regard to the above recipe that sets forth a mode of gilding, silvering, and coppering, which seems far too easy to be feasible.—ED.]

Oval Turning Lathe.

MAD JACK writes in reply to S. (*Coatbridge*):—"What you want, I think, is a spoke or copying lathe. You can get one from A. Ransome and Co., Stanley Works, *King's Road, Chelsea, London*. It is for shaping spokes, gun stocks, adze, pick or hammer handles, lasts, and other similar articles to a pattern. It will cost about from £80 to £130.

C. M. (*Brighton*) writes in reply to S. (*Coatbridge*):—"Such articles as oval hammer and pick handles are turned in a self-acting lathe with what is called a dummy, which is an article in metal of precisely the same shape and size as is desired to be turned. An overhead motion drives a saw rapidly in an opposite direction to the object, and the guide or dummy brings up the saw to its work. If you visit the Enfield Rifle Factory, the tool best worth notice is a lathe which makes rifle stocks out of rough sawn bits of wood. I believe the Britannia Company, of *Colchester*, make such tools.

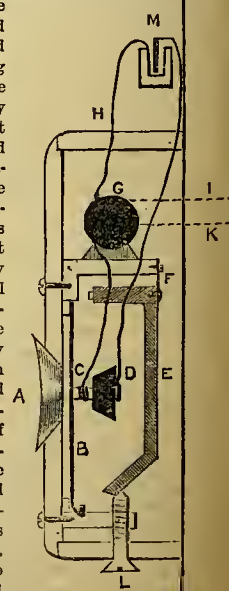
Zincography.

C. C. V. writes in reply to W. C. (*Dumfries*):—"Messrs. Wyman and Sons, *Great Queen Street, W.C.*, publish an excellent work on Zincography, price 2s. 6d."

The "Blake" Transmitter.

TWIST DRILL writes in reply to BINGO:

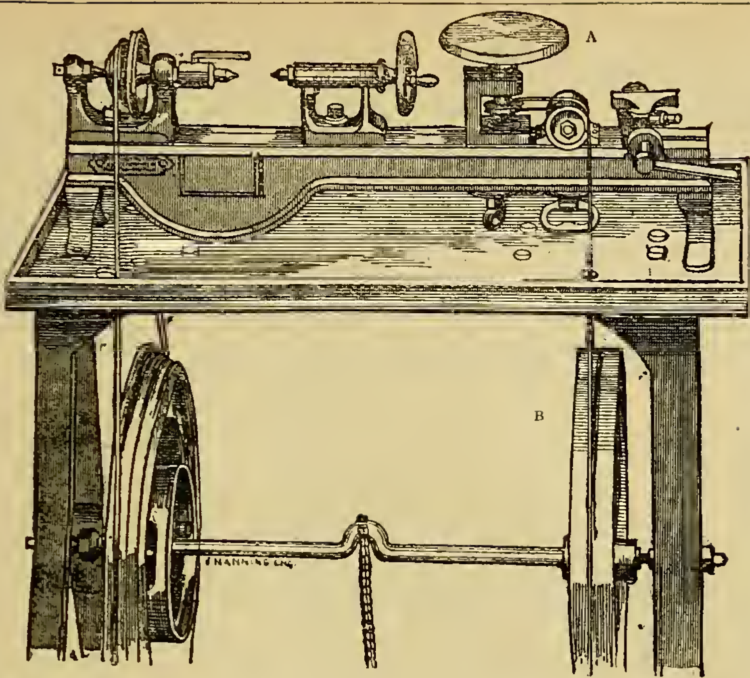
"I enclose a rough sketch of the 'Blake' transmitter. A is the mouthpiece, and B a diaphragm, against which the platinum pellet C and the carbon pellet D are pressed by separate springs S, S, fixed in, and insulated by the hanging piece of ebonite E, suspended by the spring F. It can be pressed forward and regulated by the screw L. The platinum pellet C is connected direct to the primary terminal of a coil G, and the carbon D to the other primary terminal, through the battery M and wire H. The secondary wire of the coil is connected to the line wires I and K. This arrangement improves the articulation. Any further help I shall be glad to give, if necessary."



THE "BLAKE" TRANSMITTER.

Lapidary's Bench, etc.

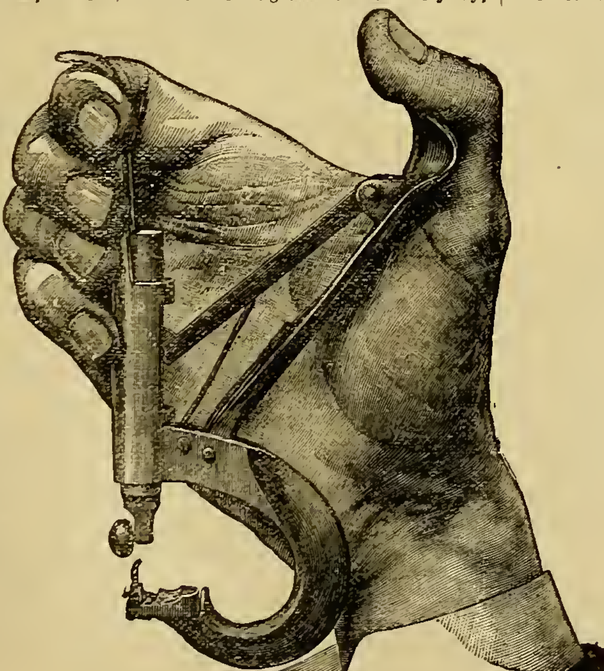
Ursus writes in reply to Lap:—"On the wrapper of Parts 38 and 39 of Amateur Work the Britannia Company illustrated a lathe fitted with a lapidary's wheel and its adjuncts, which wheel, indeed, can be fitted to any lathe. It is generally fixed upon the right hand end of the lathe, and it would then require an extra wheel, as shown in the illustration, to drive the horizontal wheel through the medium of guide pulleys. It is not an expensive appliance, and can be fixed in two minutes upon the lathe." [For the convenience of readers the illustration to which reference is made above, is given here. The lapidary's wheel is shown at A, the extra wheel at B. For price and other particulars readers should write to the Britannia Company, *Colchester*, stating size, etc., of lathe to which they desire to fix the wheel.—Ed.]



LATHE FITTED WITH LAPIDARY'S WHEEL.

About Boot Fasteners.

Mr. F. Mitchell, Family Boot Warehouse, 157, *Snargate Street, Dover*, writes with reference to fasteners for buttons:—"I have not used the 'Harrington' Clasp mentioned in page 240 of this volume on boots, but I have tried various other appliances equally as ingenious, and after the same style. My advice is, *have nothing to do with them for the foot covering*. The main objections are: First, they take too long to move should the buttons require altering; secondly, they catch in the dress or trousers and wear them ragged; thirdly, and most important, *they get bright*, which detracts from the appearance of the boot, and is to my mind sufficient reason for discarding them. Several inquiries have been made about fasteners in Amateur Work, and I take the liberty of calling attention to the *two best in my estimation*. The fasteners generally used by the public is 'Wright,' the 'Acme,' and the 'Imperial.' This last one is *put up in a most convenient form*, and I have sent you a card containing, as you will see, two dozen buttons and fasteners retailed at 3d. The cards can be had wholesale at 24s. a gross (they will supply quarter of a gross) from Messrs. Edwards and Co., 24, *Queen Street, Walsall*. The fastener we use ourselves in the shop is Pratt's Patent, and is *the best in the market*. We use grosses of them every day, and after trying every other make can testify to its superiority. It is sold in this country by the English and American Machinery Company, *Worship Street, Finsbury, London, E.C.* The price is absurdly low, for the instrument, which is nickel plated, is supplied at 4s. 6d. (wholesale), including one gross of fasteners, and a pair of nippers for removing them if necessary. I have enclosed a card, so that you can give a drawing if you like. I have no doubt that Mr. Gardiner, the manager, would send you a small block if you make application to him for it; and I think he would send a set to anyone who wrote enclosing P. O. for 5s. (6d. being for postage). The price of the fasteners is 6s. per gross." [The specimen card of the "Imperial" buttons sent by Mr. Mitchell is cheap enough, containing as it does, two dozen buttons and fasteners, and a steel button hook, but I am told by those who have made trial of them that the wires used to fasten in the buttons tear the stockings, and hurt the hands of those who clean them. I am therefore inclined myself to give preference, as Mr. Mitchell does, to the Pratt Pad, which can do no harm of this kind, and, as far as I can judge, without having handled the instrument shown in the annexed illustration, for fastening them to the leather, are easily attached, and when fastened are so thoroughly secure that it would be difficult to detach them without pulling the little plate at the under side of the leather right through the leather itself.—Ed.]



PRATT'S PAD AND FASTENER.

C. R. Namdhah writes:—"Under this heading Clericus writes in reply to Cobbler's inquiry in page 192. The inquiry was 'where could Wright's Patent Excelsior (or Climax) Button Fasteners be obtained?' Clericus does not answer the question, but the fasteners he introduces to the readers of Amateur Work are Heaton's Button Fasteners; sole manufacturer Heaton Button Fastener Company, *Providence, Rhode Island,*

U.S.A. They are obtainable through the London and Westminster Supply Association, Limited, 10, 11, and 12, *New Bridge Street, London, E.C.*, and I should fancy through any supplier of shoe-making materials. A strong pair of pliers with a slot in one jaw to hold the button shank, and a hollow—(⌣)—in the other jaw to receive and turn the three points of the fasteners are necessary. I have used these fasteners for years, and find them invaluable, especially for children's boots, and as a saving to mother's fingers." [Clericus sent me a broken fastener as a specimen, and on comparing with this the complete button and fastener that you sent, I find you are right in pronouncing the button fastener, to which he alluded to be Heaton's Button Fastener.—Ed.]

Clericus writes:—"I do not know where these can be bought, but will endeavour to find out. When I was last at the shop I mentioned, they had none of the kind. It is in *Whitcombe Street*, on the right hand side as you go up from Pall Mall East. I think it is called the 'Co-operative Boot and Shoe Company.' As a special pair of pliers is required, one might perhaps hear something about them at Melhuish's. [I am afraid not.—Ed.] I enclose a broken one for your inspection, from which you will see they are light enough, and strong enough withal. The button was torn out by a too violent use of the button-hook. Any button with a plain loop will fit them, I fancy."

Shoemaker's Wax.

Mad Jack writes in reply to J. L. D. (*New Quay*):—"To make shoemaker's wax, take 2 pounds of British pitch, 1 ounce of tallow (in winter 2 ounces), a small piece of resin. Break the pitch into small pieces, and put them into a pot. The sides and bottom must be greased. Place the pot on the fire, and when the pitch is melted, put in a small piece of resin and the ounce of tallow. Have a pail of cold water ready, and when the mixture is boiling turn it into the water. When cool work and pull it like putty."

Cutting Glass Bottles.

R. B. (*Bedale*) writes in reply to J. B. C.:—"Have you not heard, nor has it ever been in print, that 'a crack' in glass can be led in any direction required simply by the application of a *heated point*. I have cut scores of bottles with red hot *pipe stems*, and vitriol carboys with a red hot *poker*. Keep the heating point a trifle in front of the crack, and it will follow the point. Use a guide, either wire or cord, if you want 'a straight-edge,' unless you have a very steady hand and eye. If there is nothing to start from 'for to form a crack,' make a strong starting point with a file. A good deep scratch will do, but the deeper the better, and you cannot but succeed."

S. E. writes in reply to J. B. C.:—"The following method of cutting glass bottles will be found to answer. I have used it successfully many times. Saturate a piece of woollen yarn with spirits of wine, and pass it round the bottle at the place where you want to divide it, *twisting* the ends in. Don't be long over it, as the spirit evaporates, and don't let the yarn be so wet as to allow any of the spirit to run down the bottle. Hold the bottle over a vessel of cold water, set fire to the yarn, and directly the flame is gone, plunge the bottle into the water. The result will be that the bottle will be cut in two along the line of the flaming worsted.

Norwegian Gimlet.

Stadt Dresden writes in reply to Goldsmith:—"If you want a Norwegian gimlet, you had better get a good toolmaker to make one. If you buy a genuine article, you will find the handle to twist off unexpectedly as the so-called steel they are made of is but sorry stuff." [Thank you for your sketch, but similar sketches have been already received from other correspondents, as you will have seen.—Ed.]

INFORMATION SOUGHT.

Glasses for Fretwork Epergne.

Epergne asks:—Can any fellow-amateur inform me where I can obtain the glasses for the fancy fretwork epergne that appeared in Part 13 of Amateur Work?

Removal of Glaze from Emery Wheel.

Rover wishes to know how to remove the "glaze" from a Union emery wheel, which has been run at too low a speed?

Cyclometer.

Rover wishes to know how to make a cyclometer?

List of Fancy Woods.

Madera Negra asks:—Can any reader of Amateur Work give me the title, price, and publisher of any book containing a fuller list of fancy, etc., woods than the very useful one in "Every Man His Own Mechanic." I believe a Mr. Archer has devoted a work to this subject, and shall be glad of any information concerning his or any other book.

Boiler Lamp.

Stadt Dresden writes:—"I want to make a lamp for a tube boiler to burn petroleum. Wicks will not do, as they smoke too much, and the widest I can obtain here (namely *Dresden*), is seven centimetres in width. I thought of using petroleum gas, but I don't know how to vaporize it safely. I want something that will play well about the tubes. Size of boilers 16 inches by 8 inches by 6 inches, eight tubes, ½ inch internal diameter, $\frac{7}{16}$ inch apart." [If you can manage to run over to England, and call on Messrs. Charles Churchill and Co., 21, *Cross Street, Finsbury, E.C.*, they will show you the "Shipman" engine, in which your want is met to perfection.—Ed.]

Stretching Satin.

Esor asks:—Can any reader tell me the proper manner of stretching satin on panels for a large screen? If tacks are used, it throws marks across the satin. Is it done entirely with glue?

Model Weaving Loom.

Mad Jack writes:—"Looking through page 336, Part 54, I came across E. L.'s reply to H. W. (*Exmouth*) *re* Steam Power Loom. I for one would like information on making a model weaving loom, one that an amateur could weave himself a necktie or such like with; it might be fixed on a sewing machine stand to work by foot. He says he would advise H. W. to make a small wooden hand loom. Will he give instructions how to make one in 'Amateurs in Council,' if the Editor can make room for it; then, if not asking too much, you might give instructions in an article in the Magazine, set apart for the next Volume if you can get it ready, to make one to work as above, with all the intricate pattern making, etc." ["The game is not worth the candle." It would be time, space, and money wasted to attempt weaving neckties of intricate patterns. Refer to any good encyclopædia and read description of Jacquard loom.—Ed.]

Blowing Organ by Electric Motor.

G. H. O. asks:—Can any reader kindly inform me of any successful attempt which has ever been made to blow an organ by means of an electro motor?

Portholes of Cylinders for Model Engine.

Model Engine.—In reference to your inquiry respecting the proper size of portholes of a pair of model engine cylinders 2 inches by 3½ inches stroke that you are about to fit up to drive your lathe, and also, what stroke the slide ought to be, and if the exhaust pipe should be any larger than the feed, I have much pleasure in supplying you with the following dimensions: Area of port equals ·057 area of cylinder; one-twentieth area of cylinder will be near enough; width of exhaust half as wide again as port; exhaust pipe double the size of feed pipe; stroke of valve equals 2 L by 2 W, L being the lap in inches, and W width of one steam port in inches.—J. P.

Organ Pipes in American Organ, etc.

Jack Pipes writes:—"Can any reader inform me whether or not it is possible to fix organ pipes in an American organ or harmonium? If it is I shall be glad to know how to do it. Of course the cost of pipes, etc., should be given, and the kind and size of pipes most suitable, and where they may be procured.

Clockwork Movements for Models.

Lap writes:—"Where can I get clockwork movements for model engines and boats, either ready-made or to order at a reasonable price?" [There are two correspondents at least, writing under the nom-de-plume of Lap. As this may create confusion, I trust that one or the other will alter his nom-de-plume in future.—Ed.]

Maelzel's Bell Metronome.

Mad Jack asks:—Can anyone give me an explanation of Maelzel's bell metronome, and how it is played?

LETTERS RECEIVED UP TO JUNE 9.

[*Replies to these in Next Part.*]

Artist; Lex; E. W. (*Holloway, N.*); D. A.; H. E. Grantham; Signalman; Stadt Dresden; Dublin Amateur; W.; R. B. (*Bedale*); Goldsmith; Waiwera (*New Zealand*); R. W. E. (*Hackney*); Mr. M. W. Dunscombe; W. A.; Rover.

ANOTHER ELECTRIC ALARUM FOR SOUND SLEEPERS.

By C. R. NAMDRAH.

READERS of AMATEUR WORK have been favoured with several papers on this subject, and there is no doubt the various plans suggested will work well, but in every case the clock is disfigured in prominent parts, considerable trouble is taken over the necessary alterations, and in some instances the clock is stopped until the sleeper awakes, and restarts it, whilst all the time a very simple appliance will do the trick without disfiguring the front of the clock in the least. Secondly, every arrangement so far suggested makes the clock a fixture, whilst in many cases it may be desired to have the clock free (loose) to be moved from place to place. All can be easily accomplished, but as I raise a second subject — the clock free — and this may seem at a first glance rather more complicated, I will treat the matter under two distinct heads: first, the Electric Alarum Clock; second, the Clock, Free or Loose, and the necessary connections.

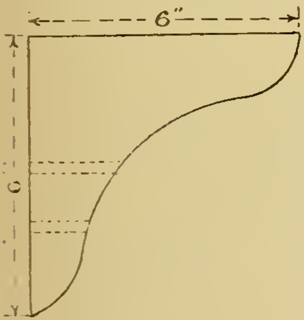


FIG. 1.—SUPPORT FOR SHELF.

First, the Electric Alarum Clock.—Open and examine any alarum clock, and mostly a spring will be found which releases the alarum. Take a piece of hardwood ¾ inch by ½ inch by ½ inch, and drill three holes through it. Pass two screws through the bottom of the clock case (whether the case be wood or metal) and into the two end holes of the wood block to secure it; drill a hole through the clock case to correspond with the centre hole in the wood block, and through this pass an insulated copper wire; cut a strip of spring brass ½ inch broad, and any suitable length. Screw the brass spring to the wood block, and connect the insulated copper wire to it, then arrange the free end of the spring immediately at the back of the spring which releases the alarum, and in such a position that on the alarum being released, the two springs will come in contact. Make another wire fast to the metal work of the clock, or if the clock case be metal, then fasten the second wire to the case, connect with bell and battery, set the alarum, but do not wind it up, and you have an electric alarum without disfiguring the clock.

The above is all that is necessary for a good, simple, electric alarum, but some readers may prefer (as I do) that the clock should be free (or loose), to be removed at any time without unscrewing binding screws, or in any way disturbing electrical arrangements; and if they will follow out my further suggestions they will easily, with a little patience and at the cost of a few pence, obtain the desired end.

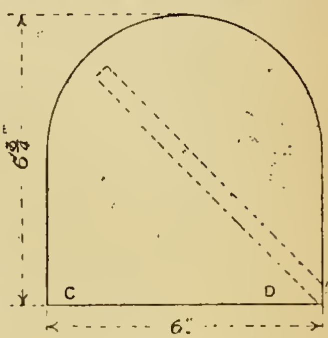


FIG. 2.—SHELF OF BRACKET.

Having fastened one insulated wire to the brass spring on the hardwood block inside the clock case, as already described, pass the insulated wire through the clock case, and in any convenient position, say underneath, affix (if the clock case is metal) another hardwood block; pass the insulated wire through the block, screw a piece of flat brass ¾ inch by ½ inch on top of this wood block, and secure the wire to it. Should the clock be in a wood case, proceed as above, only instead of fastening the flat brass ¾ inch by ½ inch to a hardwood block, secure it on the underside of the outside wood case without a hardwood block. Now as to the second wire, one end of which is fast to the metal work of the clock. If the case is wood, bring it through the case and fasten it to another flat piece of brass ¾ inch by ½ inch outside and under the clock case, but if the clock case is metal do away with the second wire altogether.

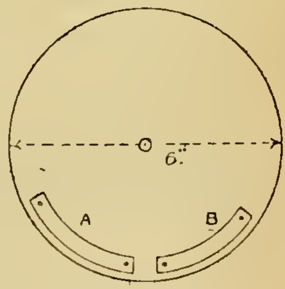


FIG. 3.—REVOLVING DISC ON BRACKET.

Your clock is now all ready. Arrange your wires from bell and battery, and determine where your clock shall stand. I find it convenient to have it on a landing where every one can see the time, and a wall bracket fixed to the side of a door-post is handy for it to stand upon, so I will presume your wires from battery and bell are fixed alongside a door-post with loose ends about 4 feet or 4 feet 6 inches from the ground.

I will now proceed to describe my wall bracket. Procure a piece of mahogany 1 foot 4 inches by 7 inches by ½ inch, and another piece 7 inches by 7 inches by ½ inch, plane and sandpaper these two

pieces carefully, then cut out of the $\frac{1}{2}$ inch wood two pieces, Figs. 1 and 2, as per diagrams, remembering they are not drawn to scale, but are to be cut to the sizes marked on them, and that the angles are right angles. The dotted lines on Fig. 1 I will refer to later. From the $\frac{1}{4}$ inch wood cut a circle, as in Fig. 3, 6 inches in diameter. Screw the shelf (Fig. 2) on top of the support (Fig. 1) as shown by dotted lines in Fig. 2, with the circular end outward in position. Pass a screw through the centre of disc shown in Fig. 3, and screw disc on top of shelf (Fig. 2) in the exact centre from side to side, and 6 inches from front. The shelf and the disc will then have their front edges even, and the disc will revolve on the shelf. Fix strips of wood on the disc so that the clock may always rest in one position. Next screw two strips of brass on the disc, say $2\frac{1}{2}$ inches by $\frac{1}{2}$ inch, as at A and B, taking care they do not touch each other. Now take the shelf, and with two screws attach a brass spring $\frac{1}{4}$ inch wide at each of the corners C and D, bending their loose ends that they may rest, say C on brass strip, A on disc, and D on strip B. Now bevel the straight edge of Fig. 1, and screw it to the door-post through the dotted lines. Attach the ends of the line wires, one to C and the other to D. Place the clock on the bracket so that strip A on the disc may have resting upon it one of the brass strips which are under the clock case, and that the second strip under the clock case, or if the case be metal, then the case itself may rest upon strip B. If the above directions have been carefully carried out, the weight of the clock will be quite enough to make good contact. Turn the disc with the clock upon it to any convenient position to wind up the clock and set the alarum, and then turn it back to its proper position, always taking care that C is left in contact with strip A, and D with strip B. I have had an American Peep-of Day clock fitted in this way working most successfully for several years, and find it most convenient, as it can be moved by a servant or child to any place where it may be required, and returned to its usual post without any trouble or loss of time.

SMITHING AND FORGING.

By GEORGE EDWINSON.

V.—SCREWING GEAR—STOCKS, DIES, TAPS, ETC.

HOLES in wrought iron, copper, and similar soft metals, should be drilled at a moderate rate of speed, and the drill lubricated with oil or a mixture of oil and strong soapsuds. Cast iron and brass should be drilled at a higher rate of speed, and shallow holes may be drilled dry. Deeper holes in massive plates will require the drill to be kept cool with soapy water. If the hole is intended to be threaded to receive a screw or a screwed bolt, the drill must be smaller than the size of the intended screw or bolt, since the operation of screwing will enlarge the hole. The object to be obtained in all cases is to leave the hole of such a size as to allow a full, well-formed thread to be cut in it when it has been enlarged to the required size. To fulfil this condition, it will be found necessary to vary the margin of difference with the size of the hole, the pitch or coarseness of the thread, and the metal in which the hole is drilled. For a $\frac{1}{2}$ inch finished hole in cast iron or brass, the drill should be $\frac{7}{16}$; but a slightly smaller-sized drill will serve the purpose for wrought iron or steel; that is to say, a worn $\frac{7}{16}$ drill will do the work. The reason is, when the thread has been fully formed in cast iron or brass, any further attempt at enlarging the hole by means of the tap is apt to result in a stripped thread, because the edges of the thread are brittle, and cannot be compressed; but wrought iron and steel will bear a little pressure without serious consequences. Coarser threads will bear being cut from holes with a larger margin, whilst finer threads should have a smaller margin than $\frac{1}{16}$ of an inch.

Screwing Gear.—The ordinary items for hand-screwing gear, or tackle, as it is sometimes termed—that is, the necessary tools for cutting spiral threads in holes drilled in metal and on metal bolts—are, 1. The Stock (Figs. 78 and 79). 2. An assortment of Dies. 3. An assortment of Taps. 4. A Wrench or Spanner to fit the heads of the Taps (Fig. 77). To these is sometimes added, for light work, a screw-plate (Fig. 80). All these various items used to be made at home by the smith in his own shop, according to his own fancy or the traditions of his teachers. As a consequence, scarcely any two smiths' work, put together with screws or bolts, were interchangeable, because each had his own pet pitch for the threads of his screws. A similar state of things existed in machine shops and large factories until Mr. Whitworth proved to the world the superior excellence of his screws and screw-cutting gear. Now, the use of the Whitworth thread has become almost universal, and the practice of making screwing gear at home has largely fallen into disuse, because superior tools can be bought for less than it would cost to make them in the smithy. Other inventions also threaten to put the use of hand-screwing gear out of the workshop altogether, excepting for very small and odd jobs. Screws and bolts and nuts are now manufactured by machinery, in all conceivable variations of size and requirement, and these are sold at such a

low price as to tempt smiths to buy the ready-made articles rather than trouble to make them at home. Screw-cutting lathes are also employed in cutting threads on screws, and thus the making of screws as a handicraft is passing away. But, in all workshops, and especially in the amateur's workshop, the necessity will always exist for the employment of hand-screwing gear, because of the numerous little odd repairing jobs which crop up, for which no provision can be made by screw manufacturers. I have been asked to give instructions for making the necessary tools required in screwing operations, and I herewith respond to that request for the sake of readers residing in out-of-the-way places. But, at the same time, I do not recommend the practice to any person, and least to those who do not own a screw-cutting lathe. Money will be saved by purchasing a good set of Whitworth's or other good make of screwing gear from such dealers as Mr. Melhuish, or Messrs. Churchill.

How to Make a Tap.—As the "tap" is the principal article in screwing gear, I will deal with that first, and proceed with instructions for its manufacture. I may say, at the outset, that there is only one perfect method of making a good tap, and that is by turning the metal to the requisite size and shape in a lathe, and cutting the thread in a screw-cutting lathe. I will not say that a set of taps cannot be made in any other way, because the job has been done by hand, without the use of a lathe, in many a country smith's shop; but the job is a tedious one, and not always satisfactory. To describe the operation in a few words, I may say that the pieces of steel are forged nearly to size and shape, finished with the file, annealed, the pitch of the threads marked on the steel by measurement, and the threads cut with files. After this, the taps are hardened and tempered to fit them for use. It will be readily understood that the work must be tedious, and the result unsatisfactory.

Presuming, therefore, that our amateur smiths have access to a metal turning lathe of some kind, and preferentially to a good screw-cutting lathe, they will proceed as herein directed to make a set of taps. First, procure 5 feet 6 inches of the very best 1 inch square cast tool steel, and 3 feet of $\frac{1}{2}$ inch steel of the same quality. If it can be tested before selection, choose that which will show a moderately fine grain when broken, and a bluish tint. Cut this up into 3 inch lengths for the smaller, and $3\frac{1}{2}$ inch lengths for the larger sizes, and carefully anneal them by heating each piece to a blood red, and allowing them all to cool gradually in a bed of hot ashes. When they are cool enough to handle, file the end of each square and true, mark the ends with a centre punch, and see that the pieces run true in the lathe, and then, to make sure that each piece will remain true whilst being turned and cut, drill the centre marks to the depth of $\frac{1}{16}$ inch for the smaller sized taps, and $\frac{1}{8}$ inch for the larger sizes. Select three of the larger sized pieces, and merely turn the corners off; reduce the remaining fifteen from square to round, by taking off all the corners; treat the smaller pieces in a similar manner, and chamfer off the edges. Now take the three largest pieces intended respectively for the 1 inch entry, half plug and full plug taps, place them in the lathe, and mark them as follows: Entry, $\frac{1}{2}$ inch at one end for square head, $\frac{3}{4}$ inch for shank, remainder for thread; half plug, $\frac{1}{2}$ inch for head, 1 inch shank, remainder for thread; full plug, $\frac{1}{2}$ inch for head, $1\frac{1}{4}$ inch for shank, remainder for thread. Run a fine gauge line around the steel to mark each division, and proceed to rough out the shape of each tap. Next take three of the remaining large pieces and rough them out for a set of $\frac{7}{8}$ inch taps, leaving the shanks and heads as for an inch tap. Then take three pieces respectively for the $\frac{3}{4}$, $\frac{5}{8}$, and $\frac{1}{2}$ inch taps, observing the same proportions as to length of shanks and threaded parts, but reducing the diameter of the shanks to allow a clearance. Beginning with $\frac{7}{16}$, and running down to $\frac{3}{16}$ inch, the smallest, the square heads must be reduced down to $\frac{3}{8}$ and $\frac{3}{16}$ inch, for the sizes below $\frac{1}{2}$ inch, and thus made to fit the two holes provided in the tap wrench or spanner. After the taps have been roughed out, they must again be heated to a blood red, and gradually cooled in hot ashes, to anneal them.

After they have been annealed, they must be again put in the lathe and turned up true and smooth, finishing off with a smooth, fine-cut file, to ensure a good even surface on which to mark the lines for the threads. It will be noticed, on consulting the table given below, that the number of threads per inch varies with the size of the tap, and this variation must be strictly observed in marking out the threads, if these are to be cut by hand by means of files, or by means of a single fine point tool in an ordinary lathe.

WHITWORTH TAPS.

Diameter in parts of inch .	$\frac{3}{16}$,	$\frac{1}{4}$,	$\frac{5}{16}$,	$\frac{3}{8}$,	$\frac{7}{16}$,	$\frac{1}{2}$,	$\frac{5}{8}$,	$\frac{3}{4}$,	$\frac{7}{8}$,	1.
Threads per inch .	24,	20,	18,	16,	14,	12,	11,	10,	9,	8.

Although I have mentioned that these threads may be cut by means of files, or by hand with a tool, in an ordinary lathe, I by no means recommend any person to attempt the difficult task, since a slight deviation from a perfectly-formed, regular-spaced thread in one of the taps will spoil the whole set; and this deviation is likely to happen even when the tool is held in a slide-rest, whilst the lathe is worked by hand slowly, and the tap is finished with a

properly-made comb-screwing tool. But with some persons the most difficult tasks are most acceptable, and therefore I have mentioned briefly two methods whereby screws and screwing tools are said by machinists to be "murdered" into existence.

The proper method is, to rough out the threads with a single fine point tool held in a slide-rest in a screw-cutting lathe, and then to finish off with a properly-made comb-screwing tool held in the same slide-rest. If the lathe to be employed is a Whitworth screw-cutting lathe, with a guide screw of 4 to the inch, the following table will show how to arrange the change wheels to cut the threads on the taps herein mentioned:—

Threads per inch.	Drivers.		Driven.
8	40	to a	80
9	80	,,	30
	15	,,	90
10	60	to a	25
	15	,,	90
11	80	,,	30
	15	,,	110
12	100	,,	60
	15	,,	75
14	60	,,	35
	15	,,	90
16	60	,,	40
	15	,,	90
18	80	,,	60
	15	,,	90
20	60	,,	45
	15	,,	100
24	40	,,	45
	15	,,	80

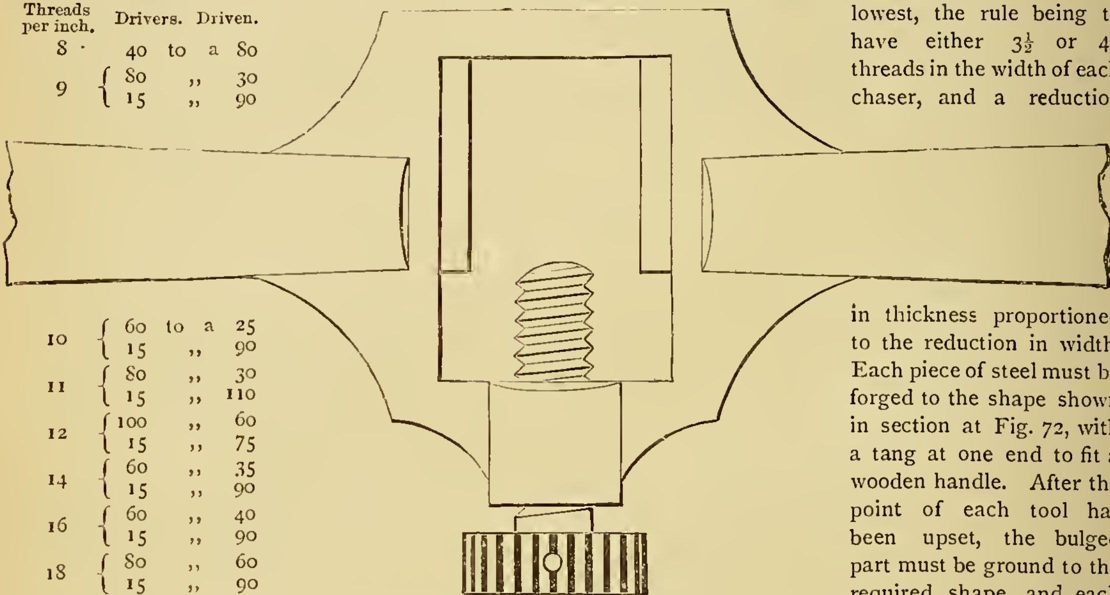


FIG. 79.—TWO HANDLE DIE STOCK.

If the guide screw has only two threads to the inch, divide the first driving-wheel by 2. This information, culled from Calvert's "Mechanics' Almanack" for 1875, is intended to assist those of my readers who know something about screw-cutting lathes. Those who wish to know the necessary changes for cutting other screws, and also the formula for other lathes, will do well to get "Calvert's Reference Book, 1874—79," price 3s. 6d., obtainable through Messrs. Heywood; Messrs. Simpkin, Marshall, and Co., and other booksellers. In this book they will find much valuable information on screw-cutting.

The threads on Whitworth's taps have an angle of 55°, the depth of the thread equals the pitch, and one-sixth of the thread is rounded off top and bottom. This can be clearly seen if a tap can be obtained for examination, and is shown at Fig. 71. The form of the thread is given to it by a special tool, known as a comb-screw, or chaser, illustrated at Figs. 72 and 73, with which the thread is formed on the tap after it has been partly cut with a single point tool. Chasers are made from pieces of flat steel, forged and cut to the required sizes. As they are each provided with teeth to match those on the taps, we shall require a chaser for each set of taps, or a set of ten chasers of various sizes. The largest size for the job now in hand should be made out of flat bar steel, 1 inch wide, $\frac{1}{4}$ inch thick, and 5 inches in length. The remaining nine chasers should be each a trifle thinner and narrower, as they run down to the lowest, the rule being to have either $3\frac{1}{2}$ or $4\frac{1}{2}$ threads in the width of each chaser, and a reduction in thickness proportioned to the reduction in width. Each piece of steel must be forged to the shape shown in section at Fig. 72, with a tang at one end to fit a wooden handle. After the point of each tool has been upset, the bulged part must be ground to the required shape, and each tool carefully annealed. The threads, or notches, must next be cut as required, with a file, with care to preserve the correct form, space, and angle of each thread, and they should then be finished by running the tool along—in a screw-cutting lathe with the proper change-wheels—against a full plug tap or hub of the desired size and pitch, until the teeth have been shaped. Chasers intended for inside work—that is, to cut threads in a hole instead of a tap, or to finish dies—must either be finished against a left-handed hub, or by filing off the lower leading edge of each tooth. The form of such tools is shown in Fig. 74. As each tap and chaser is finished—before they are hardened—stamp them with numbers indicating their size, and also the number of threads per inch.

Both taps and chasers must now be hardened and tempered. To harden them, heat each piece to a blood-red heat, and plunge them, one at a time,

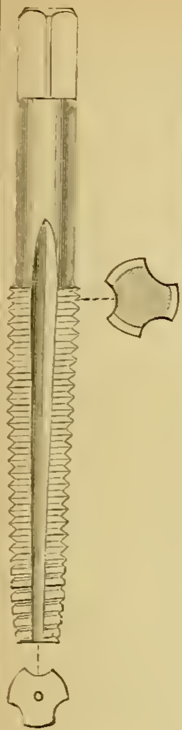


FIG. 76.—
$\frac{3}{8}$ IN.
FLUTED TAP.

FIG. 75.—
$\frac{3}{8}$ IN.
GROUND TAP.

FIG. 72.—SCREW CHASER—SECTION.

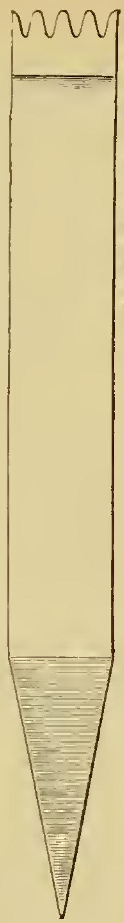


FIG. 73.—UPPER SIDE OF SCREW CHASER.

FIG. 74.—INSIDE SCREW CHASER.

FIG. 78.—
SINGLE HANDLE DIE STOCK.

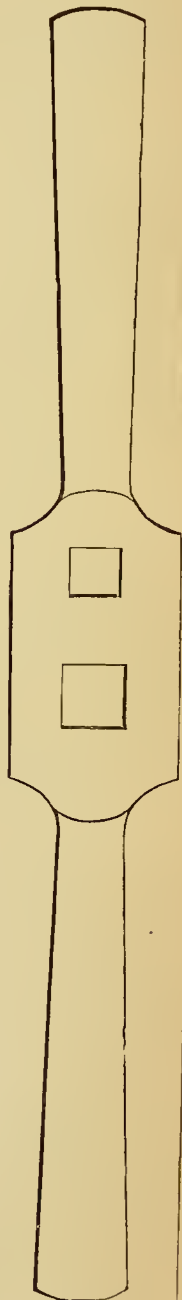


FIG. 77.—
TAP WRENCH.

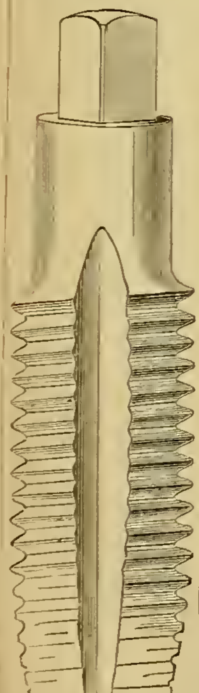


FIG. 71.—1 IN. ENTRY TAP.

FIG. 81.—SECTION OF DIE STOCK, SHOWING GROOVE IN EDGE OF DIE.

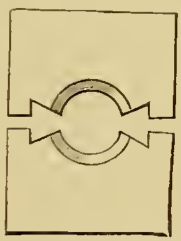


FIG. 82.—PAIR OF $\frac{3}{8}$ IN. DIES.

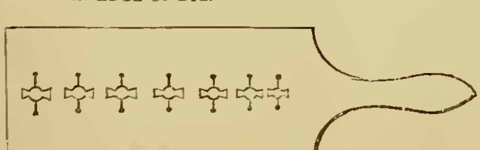


FIG. 80.—SCREW PLATE.

straight down into a pailful of salt water—one handful of common salt to each pail of water. Swirl t h water around with a stick held in one hand, whilst the other is occupied with the heated tap, and then insert this into the middle of the swirl. In this way the tools will be prevented from warping in cooling.

The tools must next be tempered—that is, brought down to the requisite hardness and toughness. Place each tool (after a part of it has been rubbed bright), one at a time, in a piece of angle iron or grooved iron, and heat over a clear fire or over a Bunsen burner, until the bright part changes to a deep yellow, then dip at once into cold water. The tempered tools must next be ground.

Chasers must have the upper surface ground level, and thus leave the upper edges of the teeth sharp. As they get warm, the surface is again ground, and thus the teeth are kept in working order. Taps have their sides and points ground down, as shown at Fig. 75; or they have three grooves or flutes cut in them longitudinally, by means of a circular cutter driven in a lathe, or with a thin emery wheel. The fluted form is preferable; but the grooves should be cut after the teeth, and before the taps are hardened and tempered. Fully $\frac{1}{2}$ inch of the point of each entry tap must be ground to a taper; a few threads of the half-plug taps must also be ground down to ensure a free entry, but the full plug must be left entire.

The wrench or spanner for the taps, shown at Fig. 77, is easily made out of a piece of $\frac{3}{4}$ inch round steel or iron, 10 inches in length. Heat in the middle, upset, flatten out $2\frac{1}{2}$ inches to $\frac{1}{2}$ inch in thickness, drill two small holes, enlarge one with a square punch to $\frac{3}{8}$ inch, the other to $\frac{1}{4}$ inch, straighten and anneal. When cool, centre each end and turn in a lathe to the required shape, then harden and temper, or case-harden. It is convenient to have a longer and heavier wrench for the larger-sized taps, and, in this case it will be found preferable to have one $\frac{1}{2}$ inch hole in the larger wrench.

Making the Stock and Dies.—The Whitworth Stock and Dies, is a compact, well-made set of tools, differing from the usual forms seen in smiths' shops, used by gas engineers, and illustrated in books. In the usual forms of screwing stocks, the dies are held in grooves, and are forced together by an adjusting screw; but, in the Whitworth stock, the dies are held in a shallow box, covered with a steel plate, and they are adjusted by means of a sliding wedge actuated with a nut and screw. As the threads on the taps are divided by flutes into three divisions, so the dies for each size are made in three sections, and their pressure is brought to bear upon three sides of the bolt. The dies on two sides are made to cut the thread, whilst the third merely acts as a guide to the eothers. A stock and set of dies of this pattern will turn out work of a superior character; but the tool is a costly one, on account of the labour and skill required to make it, and this places it out of the reach of the amateur smith.

I must therefore describe a more easily made stock, and dies of a more simple form. Fig. 78 illustrates a small stock, suitable for dies to cut screws from $\frac{3}{16}$ up to $\frac{7}{16}$; and Fig. 79 illustrates a large stock, with two handles, capable of taking larger dies. We will take the smaller size first. Take an 8 inch length of $\frac{5}{8}$ inch round iron, of good quality, upset $2\frac{1}{2}$ inches of one end to form material out of which to forge the die-holding part. Forge down the two edges to $\frac{7}{16}$ inch, and leave a rounded ridge along the centre of both sides. We shall want a boss $\frac{5}{8}$ inch in diameter to hold the adjusting screw. When the forging is complete, it should be $\frac{5}{8}$ inch in the thickest part, $\frac{7}{16}$ inch at the edges, and $1\frac{1}{2}$ inches in width, whilst the enlarged part should be $2\frac{1}{2}$ inches in length. This being done, proceed to file the stock, and form it as near as possible by this means to the finished tool. When the boss at the end has been shaped, the flat part squared true ($1\frac{1}{2}$ inches in length from boss to handle), and the corners taken off, mark both ends with a centre punch, set the work in a lathe, and turn the handle to the required shape. Then scribe a line down the centre of one flat side, and two lines about $\frac{1}{4}$ inch in from the sides, one on each side. Dot the centre line with several centre punch marks, and drill a series of $\frac{3}{8}$ inch holes, touching each other along the line. Then place the stock in a vice, break the holes into a long slot with the point of a file, and enlargen this on both sides to the required dimensions. It will be noticed in the illustration, Fig. 78, that one part of this opening is narrower than the part nearest the adjusting screw. We must, therefore, scribe two more lines on each side $\frac{1}{8}$ inch further in than the two first, and be careful not to enlarge the opening sufficient to encroach on these lines. Carefully file up to these lines, and make each inside edge true, straight, and parallel to each other. Too much care cannot be taken here, for on the perfection of this part will depend the working of the dies. We should now have a slot $1\frac{1}{2}$ inches in length by $\frac{3}{4}$ inch in uniform width. Next file $\frac{1}{2}$ inch of the slot nearest the boss to a width of 1 inch, or to the scribed marks, then scribe a mark down the *centre* of both inside edges of the slot, and proceed to file both bevels to form the ridge on which the dies are to slide, as shown in section at Fig. 81. Great care must also be exercised here, and the very best work and finish put in this part. The next job will be to drill a hole through the boss at the end,

and tap it with a $\frac{5}{16}$ inch thread. The screw for this should be of best steel, and be furnished with a head $\frac{1}{2}$ inch by $\frac{7}{16}$ inch, with a "tommy hole" drilled through the head, and the whole surface roughed with tiny grooves made with a rat-tail file, to ensure a grip to the finger and thumb of the workman. The length of the whole screw must be sufficient to close the two dies tightly, or, in other words, for the point of it to slightly encroach on the space in the slot allotted for the dies. After the stock has been thus fitted, the flat part may be thinned down to $\frac{3}{8}$ inch, and furnished with a few touches from a fine file where needed, then polished with emery cloth and oil, when it will be ready to be case-hardened.

Case-hardening.—This is a process for making the surface of iron tools almost as hard as steel. We wish to harden the surface of the stocks and tap wrenches just finished, and set about the job in the following manner: First, crush to powder and mix well together equal parts by weight of prussiate of potash, common salt, and sal-ammoniac (say $\frac{1}{4}$ lb. of each), and put the mixture in a stoneware jar or old crock. Spread a thin layer of the mixture on a piece of sheet iron, heat the tool to a cherry red, and roll it in the mixture until it is well covered with the powder, then set aside to cool. When cool, heat up again, and rub the mixture well into the surface; repeat the third time, then, when cool, heat up to a cherry heat, and quench in clean cold water.

The Dies must be made from steel, equal in quality to that used for the taps. A pair of oblong blanks $\frac{7}{8}$ by $\frac{5}{8}$ by $\frac{1}{2}$ inch will be required for each size, from $\frac{7}{16}$ downward. After they have been forged and annealed, they should be reduced by filing to a shade less than the above, the grooves cut in the edges to exactly fit the ridges in the stock, and then finished off smooth with a fine file. Fix each pair of dies in the stock, screw up tight, centre punch the position of the hole, then drill and tap them the required size. When this has been done, take them out of the stock, place them one at a time in the vice, and file the notches each side, as shown in Fig. 82. Be careful in doing this, for the corners thus made are the cutting edges of the dies, and if too much is taken off the dies will be too small. This form is the most convenient for the amateur to make, and dies thus made do their work well. When all the dies have been thus forged, drilled, tapped, and cut, they must be hardened and tempered in a similar manner to the taps, as before directed. In making a stock and set of dies we must bear in mind that there are limits to the size of bolts or screws that can be cut from the dies suitable to be worked in one stock; therefore, in planning out a stock, we must make provision for the largest size dies to be worked in that stock, for dies must be made with metal enough in them to clear the holes made in them. For instance, the stock illustrated at Fig. 79 will not take a larger die than will cut a half-inch screw. To make this suitable for larger sizes the central part must be made more massive, and the opening widened to at least $1\frac{1}{2}$ inches between the ridges on which the dies slide.

Before attempting to cut screws on a bolt, run a file around it to take off scale and dirt, as this will ruin any set of dies. Also keep dies and taps well oiled when at work, and avoid straining them with heavy work above their sizes. Do not attempt to file or grind dies to make them cut a full thread on a small bolt, but keep them to their respective sizes. Always well clean and oil all screwing gear after it has been used, before putting it away, and keep it in a box with compartments for each size of die and tap. (*To be continued.*)

DYNAMO CONSTRUCTION AT HOME.

By QUATREPOLES.

A FEW hints as to the construction of a dynamo machine, capable of yielding a light of 70-candle power, may not be without interest to those of our readers who dabble in electricity. The machine I propose describing will consume about $\frac{1}{2}$-horse power, and I assume that the amateur who is desirous to construct it knows a little about electrical science, and is familiar with the terms which are of everyday use.

A galvanometer and a battery will be necessary for testing, both of which may be of the simplest kind. The former may be made of an ordinary pocket compass, with a needle not shorter than $1\frac{1}{2}$ inch. We lay the compass on a table and allow the needle to come to rest, then wind about six turns of No. 26 silk, or cotton-covered copper wire, from us, over and under the needle, but parallel to the direction of the needle when at rest. Begin to wind at the north end, leaving a short length of the wire free for connection, and finish winding also at the north end. Strip 1 inch of the insulation from the ends, and clean them with sand-paper, bending each into a small loop. Our galvanometer may now be fixed to a small baseboard. Pass a small binding screw through each loop, taking care to screw the terminals into the boards so that the north pole of the needle points right between them. At the side of the binding screw to which the wire is attached that goes over the needle, write the word "over," and at the other screw write "under."

It will now be necessary to learn, by practice, two very important rules in electricity, in order to use the galvanometer rightly ; and here it may be mentioned, that before a current is passed through it, the galvanometer should always be so adjusted that the needle lies parallel with the coil of wire. The rules referred to are as follows :—(1.) A positive current passing over the needle causes its north pole to turn to the left. (2.) A positive current passing under the needle causes its north pole to turn to the right. In other words, if we connect the wire that comes from the positive pole of a battery (the carbon or the copper, as the case may be), to the "over" binding screw, and the wire that comes from the negative pole (the zinc) to the "under" binding screw, and face the north pole of the needle, it shall be deflected to the left. If the connections be reversed, the deflections are also reversed. The same law holds good if, instead of passing a current over or under a needle, we pass it over or under a bar of iron or steel wound with a coil of wire. A north or south pole may be produced at will if we remember Ampere's well-known rule, that the north pole is always to our left, if we suppose ourselves swimming with the current and facing the mass over which the current is passing.

Coming now to the battery, the simplest form to use is the bichromate, with one zinc and two carbons immersed in a solution of bichromate of potash and sulphuric acid. The containing vessel need not be of the usual bottle shape. Ordinary jelly jars, about 5 inches deep and 3 inches diameter, suit just as well. A ring of brass may be fitted tightly round the neck of the jar, and to this ring may be soldered one end of a short length of stout brass wire, bent towards the jar in the shape of an inverted L, with a small hook at the other end. To this hook the zinc is to be suspended when the battery is not in use.

The Castings.—The most satisfactory way to procure castings for a dynamo is to purchase them either rough or finished from makers of the machines. Castings from "the nearest foundry" often find their way back to the scrap-heap, on account of the iron being too hard, and consequently useless for dynamo construction. The softest possible iron must be used, because the softer the iron the greater magnetic susceptibility it has.

Fig. 1 is a diagram of the field-magnets of our machine : A being a side view, B the back view, and C the channel, in which the armature rotates. Both field-magnets are alike, and, if procured rough, two holes must be drilled and tapped in the flanges at the top and bottom of each limb, 4 inches apart, as at G, H, their diameter and thread being made to correspond with whatever size of bolts and nuts may be decided upon. Holes must also be drilled and tapped for bolts at each end of the pole pieces, as at D, $1\frac{3}{8}$ inch from the base, and $\frac{1}{2}$ inch from the edge of the curve of the channel. The inside of the top flanges must be perfectly bright, and fit neatly. The channel, which is $5\frac{7}{8}$ inches long, must be perfectly true, and made bright by being skinned, if necessary. E, F, W, W′ is the wire space.

The Armature is of the Siemens' H type, and may be either solid or laminated. The improved form of the latter, patented by Mr. H. Jones, of 48, *High Street, Lambeth*, is to be strongly commended. Being built in layers of the best charcoal sheet iron, the air spaces admit ventilation, and the armature is kept cool while revolving. If the armature be solid, twenty minutes' work will heat it, and the heat not only increases the resistance of the wires, but may ruin the insulation.

Fig. 2 shows one of the discs of which the armature is made, drawn to size. The number of discs required will be about 132, with a $\frac{3}{8}$ inch hole in the centre for the shaft.

The shaft (Fig. 3) may be made of mild steel, turned perfectly true, $\frac{5}{16}$ inch in diameter. From B to C make a thread, which the nut B will fit. A A are collars. Between A and B the discs are to be placed on the shaft (having previously made them flat and free from bends), in alternate positions. There must be no possibility of a counter-motion in the discs while the armature is revolving, so that the nut must be screwed up tight. The armature, when built, will have a slot on each side, which is to contain the wire.

The Commutator.—At the distance of 1 inch from the nut we fix the commutator, which is to be firmly screwed in its place. It consists of a small cylinder of box-wood, turned true, 1 inch diameter and $\frac{7}{8}$ inch long. After being turned, it must be steeped in melted paraffin wax for 20 minutes, and allowed to drain. Then screw tightly on the thread of the shaft. A piece brass tube, $\frac{1}{16}$ inch thick, which fits the box-wood cylinder is now to be cut with a fret-saw, into two equal halves, diagonally, as shown at Fig. 4. At A and B of each half a small hole is to be drilled to fit $\frac{1}{4}$ inch screws. These are to be at the end of the commutator which shall be nearest the slot. These halves are to be fixed to the box-wood cylinder, separate from each other by $\frac{1}{16}$ of an inch, and are to be so placed that the line of axis of the armature shall pass right across the centre of each slit. Short pins may be used to fix them to the box-wood, but care must be taken that these pins are not long enough to go through the box-wood and touch the shaft, or the machine would be short-circuited.

The Bearings.—The bearings should be made of gun-metal, both of them the same shape, but one with

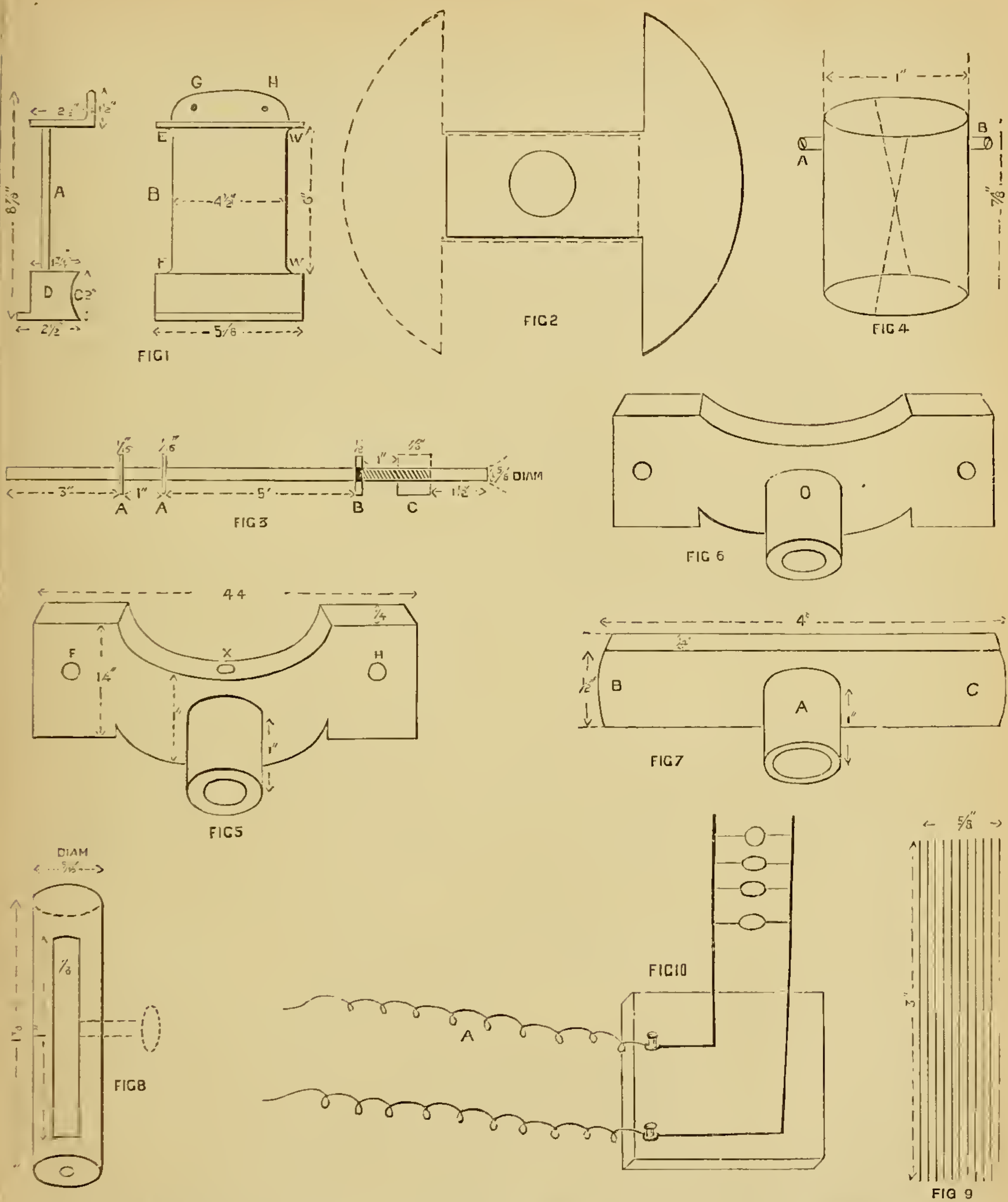


FIG. 1.—FIELD MAGNET—A, Side; B, Back; E F W W', Wire space, ⅝ inch thick; C, Armature Channel; G H, Position of Holes in Top Flange. FIG. 2.—DISC OF ARMATURE, DRAWN TO SIZE. The dotted line shows how the Discs are built on the shaft. FIG. 3.—SHAFT OF ARMATURE—A, B, Collar and Nut between which the Discs are built; C, Position of Commutator. FIG. 4.—THE COMMUTATOR, $\frac{1}{16}$ INCH THICK—A, B, Quarter-inch Screws. The dotted lines show the directions of the splits of the tube. FIG. 5.—THE FRONT BEARING. FIG. 6.—THE BACK BEARING. FIG. 7.—BRUSH SWIVEL. FIG. 8.—BRUSH HOLDER WITH SET SCREW. FIG. 9.—BRUSH. FIG. 10.—LAMPS ARRANGED IN PARALLEL ARCS—A, Wire leading to Dynamo.

a bigger belly than its neighbour. The larger one supports the shaft at the commutator end, called the "front" of the machine, and is so designed to make room for the commutator : the smaller one supports the shaft at the opposite end, which is called the "back" of the machine.

Figs. 5 and 6 show the bearings—Fig. 5 for the front, Fig. 6 for the back. The bushes must be drilled to fit the spindle, so that it can revolve easily, and in the flanges at F and H holes must also be drilled, corresponding with the holes in the pole-pieces of the field-magnets. Observe the position of the lubricator on the front bearing at X. Fig. 7 is the brush-swivel, the bush of which is drilled to slide over the bush of the front bearing, and is held by an adjusting screw at A. At B, C of the brush-swivel a small hole is to be drilled, $\frac{1}{4}$ inch diameter. A small plug of boxwood is to be tightly fitted in each hole, and bored with a gimlet to fit binding-screws. The thread of the binding-screws should be 1 inch long, as they have to secure the brush-holders at the back of the swivel. Before fixing the binding-screws, make four small washers of boxwood, $\frac{1}{2}$ inch diameter and $\frac{1}{8}$ inch thick with holes corresponding to B and C of the swivel. These have to be placed at B and C to prevent contact between the shoulders of the binding-screws and the swivel at the front, and between the swivel and the brush-holders at the back.

The Brush-Holders (Fig. 8) are small rods of brass (solid) $1\frac{3}{8}$ inches long, $\frac{5}{16}$ inches diameter, each with a slit 1 inch long and $\frac{1}{8}$ inch deep, the end of each being drilled and tapped in the centre to fit the binding-screws passing through the swivel at B and C.

The Brushes (Fig. 9) are made of lengths of brass wire, No. 20 gauge, 3 inches long, the lengths being arranged in two rows, one above the other, and soldered together at one end. A thicker or a thinner size of wire may be used, provided sufficient lengths are cut to make each brush $\frac{3}{8}$ inch broad, when all the wires are laid close together.

Fitting the Parts.—Before winding the wire on our machine, it ought to be put together to see that all the parts make a true fit. For this purpose a base-board will be necessary. It may be made of any well-seasoned wood, 12 by 9 by 1 inch. The machine is to be so placed upon it that the back end of the shaft shall project about two inches from that end o the board. Bolt the field-magnets together tightly at the top-flanges by bolts and nuts. Then bolt them in position at the base, by the bottom-flanges, having the heads of the bolts beneath the board, and the nuts above. Now take the large bearing and bolt it to the front of the pole-pieces. Place the armature in the channel, commutator first, passing the end of the spindle through the bearing. Bolt the back-bearing to the back of the pole-pieces in the same manner, passing the other end of the spindle through it. Now rotate the armature in the channel, and if all is true, it should run smooth without being caught in the channel. The result to be desired is that the field-magnets be as close as possible to the armature without touching it. To attain this the armature should run perfectly true in the channel, and if the spindle is true there should be no difficulty here. The slightest touching must be remedied with sand-paper, applying it briskly to the channel, and to the sides of the armature which fit it. The brush-swivel may also be fitted to the boss of the front bearing, which it should fit easily, so that the brushes may have their proper adjustment on the commutator. Having seen that the parts make a good fit, they should all be marked, and the machine may be taken down. The marking is to make sure that, when wired, the parts may be rebuilt in precisely the same manner.

The Wire.—To wire our machine 10 lbs. of No. 16 double cotton-covered copper wire will be necessary for the field-magnets, and 1 lb. of No. 20 double silk-covered copper wire for the armature. The wire should be new and soft, free from kinks, and of the highest conducting power : the employment of old hard wire is not conducive to success in the construction of any electrical apparatus. Before winding the No. 20 wire it should be tested for continuity by passing a current of electricity through it. Connect one end of the reel of wire to one terminal of the galvanometer, the other end of the reel to one pole of the battery. On touching the vacant binding screw with the other pole of the battery, the needle should show a large deflection—proving that the wire is continuous. If no deflection occurs the wire is broken, and the break must be found and remedied. To do this the wire must be wound on another reel, passing it slowly through the fingers till the break is reached. The broken ends may be separated, and about $\frac{1}{2}$ inch of the silk covering unwound, cleaning the bare ends with sand-paper. They are now to be filed the shape of an ordinary splice, and soldered, using resin as the flux. The silk covering is then to be carefully replaced, making good the insulation without increasing too much the thickness of the wire at the joint. The freel may now be placed in a warm oven for half an hour to drive off any moisture, and, while warm, plunged into a dish of melting paraffin wax, and steeped for one hour. After steeping, the superfluous wax may be drained off by setting the reel across the mouth of the dish. When all dripping ceases the reel may be laid aside, in any cool place, till we prepare the armature to receive the wire.

Preparing and Winding the Armature.—The

slot of the armature should first of all receive a coat or two of good Brunswick black, one coat being dried in the oven before the other is applied. Strips of silk must then be cut to fit the slot and its edges. These strips are to be steeped in paraffin wax, and applied while warm, making them smooth with a warm rag. The armature, so far as the wire is concerned, must be covered with silk, as the wire must not touch the iron at any part.

We may now proceed with the winding. Make two inches or so of the wire on the reel into a helix, by winding it on a pencil and sliding off. Begin to wind at the commutator end, laying the wire close up to the left side of the slot, temporarily securing the wire to the side by a narrow piece of tape to prevent it springing. Hold the armature in the left hand, and place the wire close and straight, taking care not to cut the insulation at the sharp corners by drawing it too tightly. Wind over and under, from you, keeping the wire free from kinks, and leaving no spaces between the wires. The shaft is only to be crossed when the side we have commmenced at is completely wound. In finishing the layer, press the wire tightly into the side we finish at. When completed, every layer must be tested for short circuiting, and when short-circuiting does occur, the place to look for the defect is where the wire is against the iron. To make this test, tie the wire down to prevent it unwinding, then connect one pole of the battery to one terminal of the galvanometer, to the other terminal connect the end of the helix we began with. Touch the iron of the armature at any part with the other pole of the battery. The needle should not be deflected. A deflection proves that there is contact between iron and wire at some point, which must be remedied by unwinding the wire and applying a fresh piece of paraffined silk wherever the contact has occurred, then re-winding and testing till the insulation is satisfactory. When the insulation of the first layer is found to be satisfactory, a strip of paraffined paper may be laid on it, and the second layer proceeded with. Each layer must be tested in the manner described, and between each layer paraffined paper may be laid, so that the wire of one layer shall not fall down to level of the layer beneath it. The last layer must not rise above the sides of the slot, for it is sure to be caught in the channel of the field-magnets during rotation. The winding should finish at the same end of the armature as we started from, but at the opposite side of the slot; and to keep the wires in their place during rotation, three short pieces of thin cord may be passed between the discs, equidistant from each other, and tied. About ½ inch of the ends of the coil are now to be cleaned with sand-paper, and formed into small loops. One end goes to one half of the commutator, and the other end to the other half, the small screws being placed in the loops and firmly screwed down.

The armature is now wound, and may receive a coat of wax varnish, made by dissolving the purest, red sealing-wax in methylated spirit. One coat of the wax varnish will be sufficient if it is made thick enough. When dry a coat or two of vermilion may be applied, which is made by mixing a little vermilion powder with white spirit-varnish. The vermilion coat adds very much to the appearance of the machine, and, with the wax-varnish, prevents damp from reaching the coils of wire.

Preparing and Winding the Field-Magnets.—The field-magnets should receive a coat or two of Brunswick black, at all parts, with the exception of the channel and the inside of the top flanges. These parts must be bright, and free from anything that would prevent good contact. The wire spaces should also receive a covering of paraffined silk.

The No. 16 wire need not be tested before winding, as any break in it will be detected as it passes through the fingers. About 6 inches of the wire are to be made into a helix, and stripped of an inch of insulation at the end. Take the limb which was to the right as we faced the front of the machine when on the base-board. Begin winding at the end of the wire space nearest the channel on the outside of the limb, with the helical end of the wire coming out to the front. This end is to be tied to the limb. Lay the wire close against the magnet, keeping it tightly pulled, placing it smooth and even, leaving no spaces between the wires. When the layer is little more than half-finished, lay four strips of cotton or any thin cloth on the vacant part of the wire space, two inside and two outside, 5 inches long and ½ inch broad, and about 2 inches apart. The wire wound tightly will keep them in their place. Wind close up to the shoulder of the wire space, leaving loose in the meantime the other ends of the cotton strips. Then proceed to wind back with the second layer—remembering that a turn of the wire of the previous layer is always missed when a fresh layer is begun. When about three turns of the second layer are wound fold over tightly the outside ends of the cotton strips on both sides of the limb, laying them on the first layer, so that the second keeps them in place. The utility of the strips will be obvious. They are to keep the first turns of each layer in their proper places, and prevent them slipping to the lower layer. Before beginning and completing each layer, both outside and inside the limb, they must be used.

In this manner 5 lbs. of the No. 16 wire are to be wound. The last layer should finish at the extremity of the wire space furthest from the channel, with the

end of the wire to the back of the limb, and tied temporarily to it. The wire may now receive a coat or two of the wax varnish and vermilion.

The other limb is to be wound in the same way, the only difference being that the winding is begun at the inside next the channel, keeping the helix to the front as before, and using the strips of cotton for every layer.

Magnetizing the Field-Magnets.—Our machine being wired, we put the magnets together on the base-board, precisely as they were fitted at the preliminary trial, bolting them firmly to each other and to the board. We then connect the ends of the wires at which we left off winding, the two ends at the back of the machine. A short length of the insulation is to be stripped off each end, carefully cleaned, and twisted together. A soldering bolt may now be run along the joint, using resin as the flux. To replace the insulation cover the joint with paraffined silk, fastening it with thread ; then bend the joined wires in between the limbs.

Before magnetizing the field-magnets it is more satisfactory to decide which limb shall be a north and which a south pole. An iron mass acquires north polarity to our left, by passing an electric current from us, over the mass ; it acquires north polarity to our right, by passing the current to us, over the mass.

Let us decide that the limb we first wound shall be the north pole of our machine ; that is, the limb to our right. According to the rule just given, the current ought to flow from the limb to the observer ; or, to put it more simply, the wire of this limb must be connected to the negative pole of the battery, which is the wire coming from the zinc. The wire of the other limb is to be connected to the positive pole of the battery, the wire coming from the carbon. A few seconds' connection with the battery will be sufficient to charge the field-magnets with as much magnetism as they will retain. The result may now be tested. For this purpose, bring the galvanometer near to the supposed north pole of the machine : if the instructions have been carefully carried out, it will be observed that the limb attracts the south pole of the needle and repels the north pole. Bringing the galvanometer near the other limb, the north pole of the needle will be attracted by it, and the south pole repelled. Our machine is therefore north to the right, and south to the left. Mark " N." and " S." on pieces of gummed paper, and stick them on the north and south poles respectively.

The Current from the Armature.—We must now ascertain in which direction the current flows from the armature. Fit the armature in the channel by the bearings, the commutator to the front. A small pulley wheel, about 2 inches diameter, is to be fitted to the end of the shaft outside the back bearing, by a key or a screw. Place the brush-swivel on the boss of the front bearing, with the brush holders secured by the binding-screws already referred to. The brushes are then to be passed into the slit of the holders, and are to be so adjusted that each presses with some force on the commutator—one above and one below. They must press equally at two points in the commutator, and these points should be at opposite ends of a diameter. Otherwise there will be sparking at the brushes, and all sparking means waste. Have the top brush to the left, and the bottom brush to the right.

Connect the galvanometer to the binding screws of the brushes, adjusting it so that the needle lies parallel to its coil of wire. The armature may be driven from a lathe, by means of a cord and the pulley wheel on the shaft. We have to discover which brush is sending the positive current. Drive slowly in the direction of the hands of a clock, and observe the galvanometer. The positive current will come from the binding screw, which, if connected to the wire marked "over" on the galvanometer, deflects the north end of the needle to the left ; and which, if connected to the wire marked " under," deflects the north end of the needle to the right. A mark is to be put on the positive binding screw to prevent any confusion. The end of the helix from the south limb is now to be thoroughly cleaned, and to the binding screw, which we have marked, "positive," this end is to be connected.

Two binding screws are now to be screwed to the base-board at the front of the machine, one at each side of the brush swivel, but clear of it, so as to allow of any adjustment of the brushes. These terminals need not be screwed right up to the shoulder at present. A short length of No. 16 copper wire is to be wound into a helix, and the ends cleaned, one end being in the shape of a loop. The loop end is to be connected to the terminal nearest the *negative* brush, passing the loop between the shoulder of the terminal and the board, and screwing it down; the other end is to be connected to the binding screw of the negative brush. The end of the wire from the north limb is also to be carefully cleaned, and bent into a loop ; this loop is to be connected to the other terminal on the board.

Our dynamo is now complete, being connected " in series," and it will be found convenient for many purposes where a powerful current is required. When driven by a lathe it should light four ten-candle power lamps (Swan's), of ten volts each, arranged in parallel arcs, as in Fig. 10. The machine does its best work, however, when driven by a half-horse power engine, the armature revolving at about 2500 revolutions a minute, when it should light seven ten-

candle lamps, arranged as shown. A powerful current can also be generated by hand-driving; and those who possess neither a lathe nor a gas engine, can easily devise a simple method of driving, by means of a not too light driving wheel, fitted with a handle, and fixed to a strong upright beam on a broad base. The wheel may have a V-groove, an ordinary sewing machine leather strap connecting it to the pulley wheel of the dynamo. The current generated by this means will not be so powerful as when generated by the power which the dynamo consumes. It will still be sufficient, however, to light two of the ten-candle lamps or four of the five-candle lamps comfortably.

ENAMELS: HOW TO PREPARE THEM.

By JOSEPH HARRIS.

II.—DEVELOPMENT OF THE LATENT IMAGE.

THE development of the latent image will be best effected by a *freshly made* solution of pyrogallic acid, 3 grains; glacial acetic acid, $1\frac{1}{2}$ drams; alcohol, $\frac{1}{2}$ dram; water, 3 ounces. Do not employ methylated finish in place of alcohol, and do not use this developer when over *two* days old. The action will be *exceedingly slow*, some seconds elapsing before the whites of the picture sluggishly make their appearance. If they come out briskly the plate has been over exposed; if the formation of the image be very gradual the time will have been correctly estimated, and as soon as the detail is fairly out in the middle tints the plate may be carefully washed under a tap, and fixed by a weak solution of cyanide of potassium being gently poured on and off till all trace of unacted iodide be removed, rinse under the tap, and critically examine the result; if perfect, the high lights will be represented by *absolutely clear* glass, and the middle tints will be *very faintly* indicated. If these middle tints have any *strength* of deposit upon them, the action of the developer will have been too prolonged, and another plate should be prepared giving the same exposure, but with a shortened development. The two plates may then be passed through the subsequent stages in order to form a guide for the future.

Toughening the Film.—In order to strengthen the delicate collection film and to facilitate its subsequent removal from its glass support, it is immersed for five minutes in a bath of common water 10 ounces, sulphuric acid $\frac{1}{2}$ dram—again rinse under the tap preparatory to toning.

Toning the Film.—This operation is necessary to convert the silver in the picture into a metal possessing greater beauty of colour when vitrified.

From Johnson and Mathey, *Hatton Garden*, procure a $\frac{1}{4}$ ounce tube of the double salt of potassio chloride of iridium, add it to 16 ounces of distilled water (not bought from the local chemist), shake well the solution and put it aside in a *dark* cupboard for about a fortnight, giving it a good shake two or three times daily during the time. This is the stock solution of iridium. From Johnson and Mathey, *Hatton Garden*, get a 15 grain tube of chloride of gold, dissolve in 15 drams of pure distilled water. This will form the stock solution of gold. To make the toning bath take 14 drams of the iridium solution, taking care not to disturb the undissolved iridium at the bottom of the bottle, and pour it into a bottle containing 12 ounces of pure distilled water, shake it well and add thereto in small quantities 7 drams of the gold solution, shaking well between each addition, not that there is any risk of precipitating the iridium, because gold is the only metal which will not precipitate iridium; but the slow addition of the gold combined with agitation causes the best and the most perfect admixture of the two metals in solution. This bath is in finest condition after having been made a few weeks, it is not advised to use it newly mixed; keep this bath in the dark.

Holding the plate in the left hand in the same manner as if preparing for coating with collodion, take for a half-size glass 3 drams of the toning bath in a clean glass measure, and slowly pour on and off the film till it has been coloured through to the back. This will take about two minutes, do not prolong the toning, or the image will be clogged up with iridium, and will burn too dark; perform this operation in the dark room, examine from time to time in bright light, wash well and carefully under the tap, and immerse for three minutes in a solution of water 10 ounces, liq. amm. fort. 3 drops, again wash and lay the plate in a small porcelain tray about half full of water preparatory to transferring the film to the enamel tablet.

The Enamel Tablet or Plaque.—These are best procured in dozens from M. Geymet, *of Paris*, or Mr. Atkinson, *Manchester Street*, *Liverpool*, will supply them. The French tablets, though slightly dearer than those of English make, are really cheaper in the end. They never crack in the firing, and the paste of which they are composed is a better colour than the English, and is absolutely free from specks. The most useful sizes for the amateur are 5, 6 or 8 for lockets, 10, 12 or 15 for brooches, 18 for ornamental purposes. Clean the tablet or *plaque* with weak nitric acid and water and lay it in a small tray half filled with water; take the transparency out of the tray in which it has remained, and with a cedar holder cut to a point, carefully break round the collodion film to a size or so larger than the tablet on which it is to be transferred. The waste film can be put aside to be dried

in the furnace and mixed with a drop or two of oil of lavender, this makes a good spotting colour for use when necessary. Having removed with the finger every trace of broken film from the glass plate, return the image to the tray of water from which it was first taken, and with a camel-hair brush very carefully turn up its edges, sometimes it will float from the glass easily, but there are occasions when it pertinaciously adheres ; it is best then to immerse for five minutes in a bath of weak sulphuric acid and water, about the same strength as before used ; again wash carefully and return to the porcelain tray and fresh water. When the film has floated remove the glass from the tray, and taking the tablet on a fair sized palette knife insert it under the film, guiding the latter to its place on the tablet by means of a fine camel-hair pencil *kept for the purpose.* When the position on the *plaque* is satisfactory, retain it in place with the hair pencil, gently lifting up the tablet on the palette knife. When free from the water take the *plaque* gently between the finger and thumb, and with one finger of the right hand cautiously remove the superfluous film which has adhered to the back of the *plaque*, lay it down on clean blotting paper, and cover with a small tray to protect from dust while drying. It is not advisable to force the drying ; the best plan is to defer firing till the following day.

Firing the Enamel.—One word here on the form "Enamel." It is but too general in this age of shams to call anything with a glass-like surface "enamelled." But as neither leather nor cardboard will bear a glaze being *fused* to their surface, this misuse of language becomes absurd in addition to its evidence of ignorance or of wilful deception. Surely those who write that others may be informed should have sufficient spirit to protest against the perpetration of error.

There are two things necessary to constitute an enamel : the first is a metallic base, the second a vitreous glaze. The vitreous glaze when fused to the metallic base constitutes the enamel. It is quite immaterial what may be the subject or picture represented on that glaze, whether it be a design in colours or a photograph in one colour, the whole thing is an enamel, nothing more is necessary so far as language is concerned to express what is meant, and hence another verbal absurdity is brought to mind—the *photographic* enamel! Truly, we English are a strange people. The photograph does not render the *plaque* an enamel, the *plaque* was an enamel before the photograph was thought of; and yet, though we pay our millions to the School Board, in our midst there exist some who speak of "photographic enamels."

The best gas muffle furnaces are those made by Mr. Fletcher, of *Museum Street*, *Warrington*, who will send his catalogue and all information to any intending purchaser. The most suitable size is his No. 1 gas muffle furnace. This should be fixed so that it will easily connect with a ½ inch pipe direct from the main ; the furnace should also have a good draught up the chimney—a good plan is to remove the grate and chimney piece from one of the upstairs rooms in the house, fixing an iron plate across the opening about 2 feet from the ground and setting the furnace thereon. Do not forget to make good with plaster any defects in cutting away, or dust and annoyance therefrom will be inevitable.

The tablet being dry, the first object will be to scorch away the collodion film, leaving on the *plaque* the metal only in those varying degrees of density which form the picture.

Light the gas turned on to about half pressure to heat the furnace. Practice will tell if a greater pressure is requisite to heat to a cherry red heat in about two hours. When the gas has been lighted lay the plaque on the top of the furnace and cover it to protect from dust with a small fireclay vessel; in about an hour the collodion film will be burnt away, leaving a dull heavy coloured impression on a brown ground ; the plaque must now be laid on a bench to cool, keeping the gas going in the muffle. In about a quarter of an hour it will be cold and ready for glazing.

From Hancock and Sons, Digh's Colour Works, *Worcester*, procure a 1lb. tin of their photographer's best enamel glaze. As much of this as will lie on a two shilling piece is added to a mixture of ½ ounce of *plain* collodion, ½ ounce of absolute alcohol, and ¼ ounce of rect. sulphuric ether, and the whole *well* shaken. When required for use, remove all dust from the neck of the bottle, shake up the whole deposit from the bottom of the bottle, and holding the plaque between finger and thumb pour sufficient to cover *quickly* the whole surface, return the excess to the stock, and with the finger drain off any of the glaze which may hang around the edge of the enamel, lay it on a piece of fireclay and insert in the muffle, as soon as the glaze has melted, withdraw the enamel and allow to cool; the whites will be glazed but the shadows will not be transparent, and the full beauty will not be apparent till three or four glazings have been applied. Care should be taken not to prolong the firing at each successive glazing ; if the glaze flow thickly add more alcohol. If the enamel burn to a poor slaty colour, too much gold has been used in the toning bath ; if it burn over black, too great a proportion of iridium has been used, and the remedy is obvious.

Here I may conveniently bring my remarks on Enamels to a close, trusting that I have said enough to interest my readers in this pleasing branch of photography, and to enable them to carry out the process if they feel disposed to attempt it.

MODEL ENGINE MAKING.

By JOHN POCOCK.

IV.—DOUBLE ACTION HORIZONTAL SLIDE VALVE ENGINE —CASTINGS—THE CYLINDER—HOW TO CHUCK IT —BORING WITH BORING BAR.

THE next engine to be described is a double action horizontal slide valve engine, and the particular set of castings from which this description is taken was supplied by Messrs. Hughes and Swift, of *Kirkdale, Liverpool.* This set includes all the castings necessary for the construction of a horizontal engine, cylinder, one-inch bore and two-inch stroke, being set No. 3 in Messrs. Hughes and Swift's catalogue. The price of the set is 4s., but it will save the amateur engine maker considerable trouble if the bed-plate and crank-shaft are ordered with the castings. The cost of the bed-plate is 2s. 9d. The charge for forging the crank-shaft is not given in the catalogue, but it would not be an expensive item, and would be a difficult part for an amateur to forge for himself. For an additional expenditure of 1s. 9d. the cylinder may be had ready bored and with the flanges turned, and I advise those readers who do not possess a good lathe to have their cylinders worked to this extent. For the benefit, however, of those who own a good, steady running lathe, I shall describe several methods of boring the cylinder, depending upon the apparatus available.

A full-sized working drawing may be had from Messrs. Hughes and Swift, price ninepence; or the reader may construct his own working drawing, either full-sized or on a smaller scale, though the latter is undoubtedly to be preferred.

Figs. 34 to 49 show the various castings included in set No. 3. Fig. 33 is the bed-plate, and Fig. 50 the crank-shaft. The bed-plate and fly-wheel are drawn on a scale of six inches to the foot, while Figs. 35 to 50 are full-sized, and Figs. 51 and 52 are not drawn to scale; in fact, Fig. 52 is a plan only. Figs. 39 to 41 are in pairs, so that the set of castings consists of eighteen separate pieces exclusive of the bed-plate. Some of these, however, are really two or more pieces cast in one; thus, Fig. 42 is to be cut up into four pieces to form the four "distance pieces," or columns, between the parallel guides. Fig. 49 also is to be divided, and will then provide the glands for the cylinder cover and steam chest; and Fig. 37, in like manner, is to be cut in two to form the two guide blocks.

The consideration of working drawings, etc., I will leave for my next paper, and for the present will describe the various modes in which the boring of the cylinder may be effected.

The Cylinder.—This is by far the most important part of the engine, for it is in the cylinder that the steam exerts its expansive power, or, in other words, it is here that the heat generated in the furnace is turned into work, and upon the accuracy with which the cylinder is bored and fitted largely depends the effectiveness of the engine. Even in a model, where the highest degree of effectiveness is not a consideration, it will be impossible to get our engine to work evenly and well unless the most careful attention has been given to this part of the construction. Those of my readers who reside in the neighbourhood of London, and who, after procuring their castings, find themselves unable to get over the boring of the cylinder to their satisfaction, will find Mr. Smelt, of 7, *Goldsmith's Row, Gough Square*, very attentive to their requirements. Mr. Smelt will undertake any machine work, either small or large, at a moderate price, and will, I think, be glad to render any assistance in his power to amateurs in difficulty. However, there is no insuperable difficulty in boring the cylinder at home. The first step, of course, is to chuck the cylinder, and this may be done in two or three ways.

First, it may be attached to the bed-plate thus: Take a circular piece of wood about quarter of an inch thick and of rather greater diameter than the cylinder end, including flange. If this piece of wood is turned up and a few concentric circles marked upon its face, it will facilitate the centring of the cylinder. Now place this piece of wood upon the face-plate, and then, after filing one end of the cylinder as flat and square as possible, place it, filed end downwards, upon the wood. Next take three dogs, *i.e.*, pieces of iron or steel about two inches long and three-eighths to half an inch thick, with a hole in the middle of each to take a bolt. Place these with one end of each resting on the flange of the cylinder and directly over three of the slots in the face-plate. Now place a small piece of wood, about half an inch thick, under the other end of each dog, and finally, pass a bolt up through the slots in the face-plate and through the hole in each dog, and screw the nuts down so that the cylinder is firmly held in place, but do not yet tighten the nuts ready for action.

Screw the face-plate, with cylinder attached, on to the lathe mandrel, and see whether the cylinder runs true. Probably it won't, so we first centre the back flange by holding a piece of chalk against it, and giving a slight tap where required with a light hammer and mallet till the back flange appears properly centred. We now test the front flange, and if the back flange, besides being truly centred, has been filed square and flat, the front will run true;

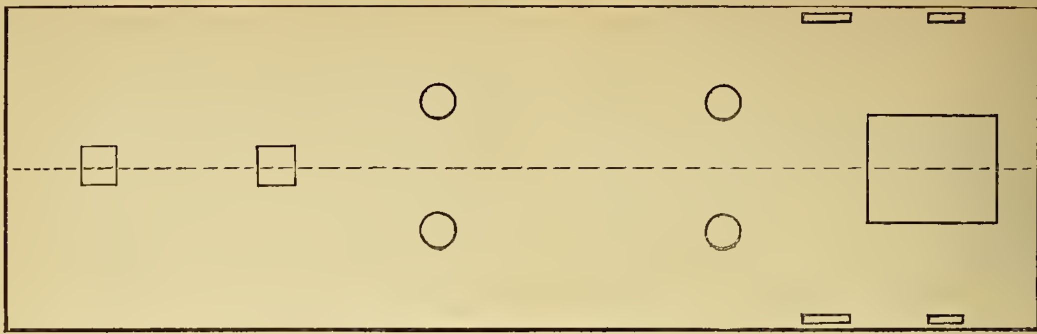


FIG. 33.—BED-PLATE.

otherwise, we must get it right by loosening slightly the nuts as required, but only one at a time, and packing up whichever side requires it with thin pieces of metal, taking care in the meantime that the position of the cylinder upon the face-plate is left unaltered. The arrangement just described is shown by Fig. 51; and when completed, and the cylinder is satisfactorily centred, the nuts must be carefully tightened up so that there may be no danger of the work shifting during the operation of boring.

Another method of chucking the cylinder, one which may be adopted by those who do not possess a face-plate is by turning up a piece of beech or box-wood, and turning in it a recess into which the cylinder flange will fit exactly. To prevent accidents, it is well to secure the cylinder in this recess by the same sort of dogs as those used in the method first described, ordinary

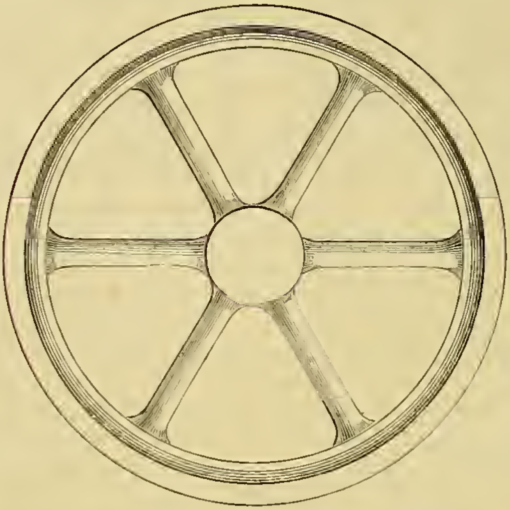


FIG. 34.—FLYWHEEL.

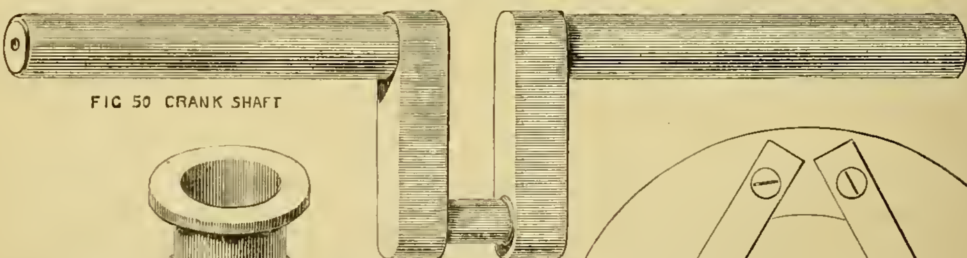


FIG 50 CRANK SHAFT

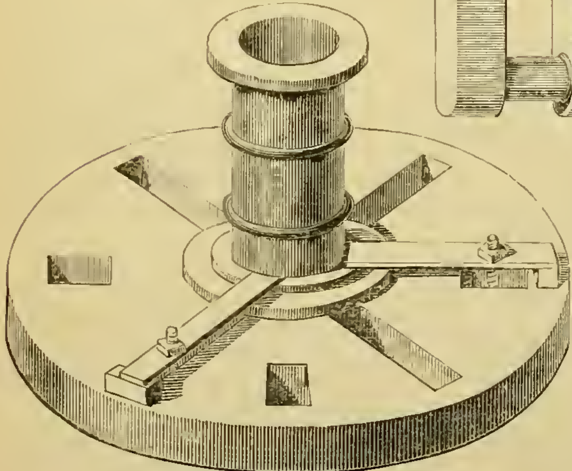


FIG. 51.—METHOD OF CHUCKING CYLINDER.

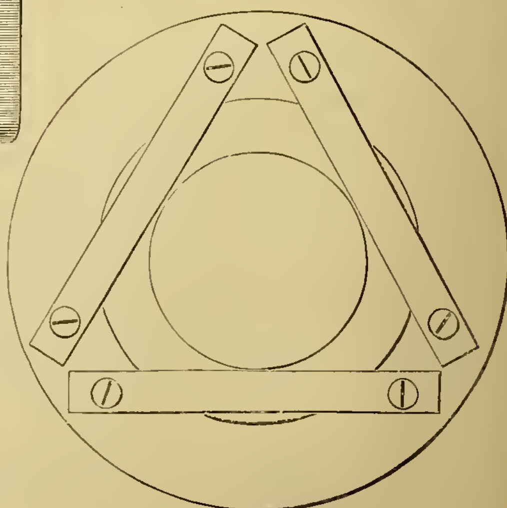


FIG. 52.—ALTERNATIVE MODE OF CHUCKING CYLINDER.

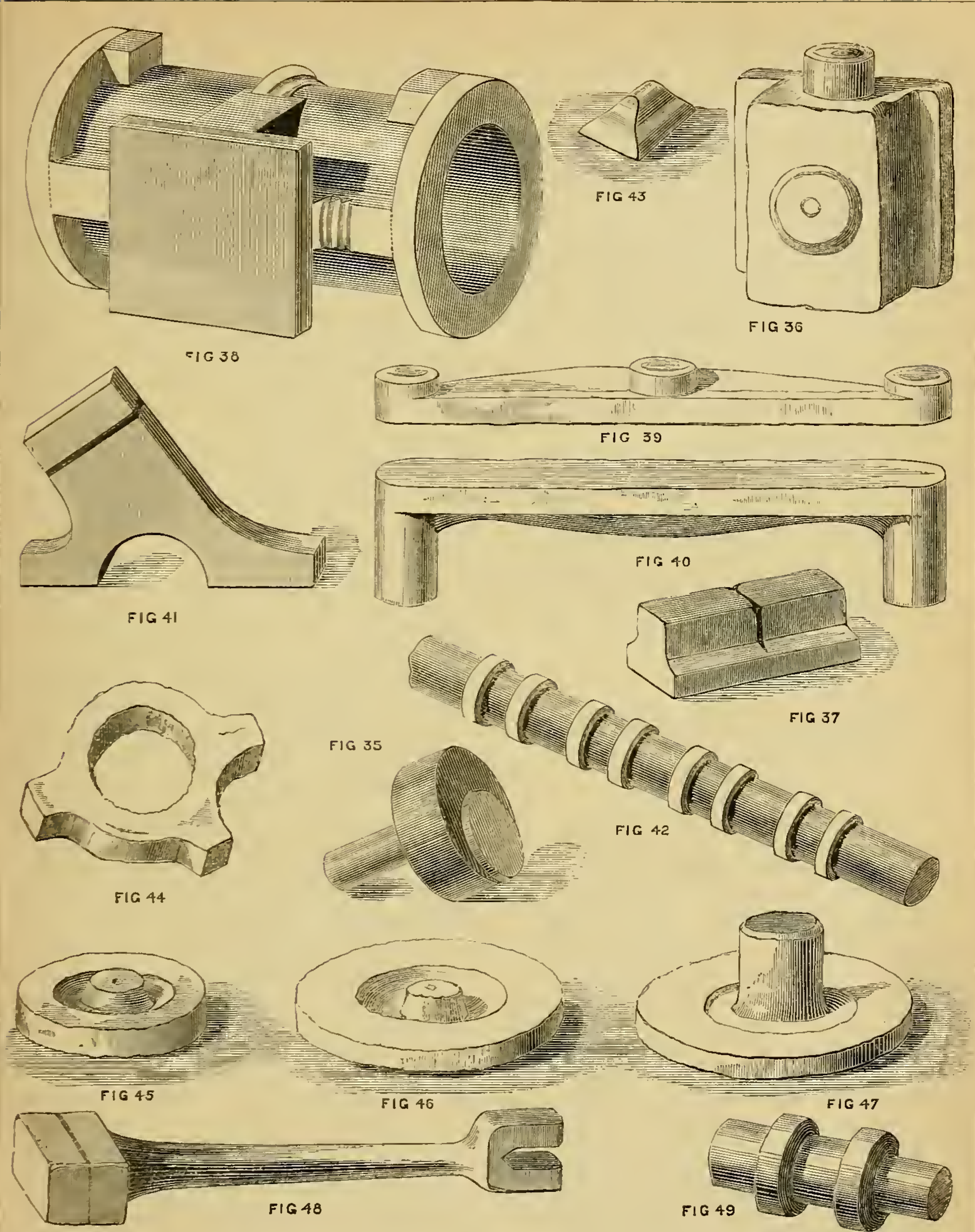


FIG. 35.—ECCENTRIC. FIG. 36.—STEAM CHEST. FIG. 37.—GUIDE BLOCKS. FIG. 38.—CYLINDER. FIG. 39.—PARALLEL BARS—TOP. FIG. 40.—PARALLEL BARS—BOTTOM. FIG. 41.—BEARING FOR SHAFT. FIG. 42.—DISTANCE PIECES FOR PARALLEL GUIDE BARS. FIG. 43.—SLIDE VALVES. FIG. 44.—ECCENTRIC BAND. FIG. 45.—PISTON. FIG. 46.—BOTTOM OF CYLINDER. FIG. 47.—TOP OF CYLINDER. FIG. 48.—CONNECTING ROD. FIG. 49.—CYLINDER COVER AND STEAM CHEST GLANDS.

wood screws being passed through the holes in the dogs into the wooden chuck; or, three pieces of iron or wood having a hole at each end, may be fastened across the flange of cylinder by screws as shown in Fig. 52.

Yet another way of securing the cylinder, is by an angle plate used with the face-plate.

If the cylinder is to be bored with a boring bar, the first two methods will have to be slightly modified, as thicker wood will have to be used, and a recess the diameter of bore of cylinder when finished must be turned in it to a depth of three-quarters of an inch, in order that the boring tool may pass completely through the cylinder.

This last method will probably suit most of the readers of AMATEUR WORK, as I shall in my next describe a simple and easily made boring bar with which the boring may be done.

Another way is to fix the cylinder to the saddle of lathe instead of to mandrel, and use a boring bar; but those who possess the necessary apparatus for this are not likely to require any instructions as to how it is to be used. I shall therefore confine myself to such methods as may be of use to amateurs less practised than we should suppose those to be who are thus fully equipped.

(*To be continued.*)

DRY-PLATE PHOTOGRAPHY:

THE GELATINO-BROMIDE PROCESS.

By C. C. VEVERS.

VI.—DEFECTS, FAILURES, AND REMEDIES—INSTANTANEOUS SHUTTERS—INSTANTANEOUS PHOTOGRAPHY—SNOW SCENES.

(*For Illustrations of Photographs, to which reference is made in this Chapter, see Folding Sheet issued with this Part.*)

FOG.—This most common of defects in negatives may roughly be divided into two classes: Chemical fog and light fog. The former is a defect, the latter usually a failure. *Light fog* is the most frequent of these two evils, and is caused by the undue exposure of the sensitive salts to light. There are several ways in which this may happen: sometimes light has acted upon the emulsion before the plates are coated; luckily, however, this rarely occurs in modern commercial plates. White light is admitted into the dark room, either through chinks, etc., in the walls or roof, or through the window, the medium covering them not being sufficiently non-actinic; the dark slide or camera is defective and admits light; or the plate has been over exposed. If the plate is fogged all over, except where it has been covered by the rebates of the dark slide or wires of the carrier, we may come to the conclusion that the light has acted upon it when in the camera, probably through a minute hole in the bellows. To see if the camera is perfectly light-tight, fold back the focussing screen, and putting your face close to the back of the camera, cover the head up with the focussing cloth; now get a friend to hold a lighted candle or match close to various portions of the camera at the outside; if there is a hole in any part, its situation will at one be discovered, and must, of course, be filled up so as to render the camera perfectly light-tight. If light is admitted through a defect in the dark slide, fog is generally shown by long, streaky lines reaching sometimes half-way down the plate; the remedy is obvious: the dark slide must be repaired. To test the light used to illuminate the dark room, put a plate in the dark slide in perfect darkness, withdraw the shutter half-way, and expose for a considerable time—say ten or fifteen minutes—near the window of the dark room; develope the plate as usual, and if one-half of the plate veils over while the remainder remains white or transparent, we may safely suppose the light is not filtered through a sufficiently non-actinic medium. It should be remembered that the light in summer is much more powerful than in winter, and a window which is perfectly non-actinic in November or December may admit a considerable amount of chemical light in June. If the plate be but slightly fogged *before* exposure Abney recommends the following to remove all traces of the action of light from the film:—Immerse the plate for half an hour in a solution of ten grains of potassium to each ounce of water, well wash for an hour, dry, and the plate should then give an unveiled picture. There is a *slight* diminution of sensitiveness if the bichromate be not all washed out, but nothing to hurt, except when very great rapidity is required.

The following is an instructive and somewhat humorous memorandum of the first dozen plates tried by an amateur friend new to dry-plate work, which clearly shows a few of the many sources of fog: No. 1 fogged—light discovered entering dark slide through an ill-fitting shutter. Dark slide repaired before trying No. 2. Nos. 2 and 3 fogged—light between flange of lens and camera; remedy applied. Nos. 4 and 5 fogged—defect discovered in bellows body. No. 6 fogged—light entering camera through old screw hole unplugged. Nos. 7 and 8 fogged—light of dark room not sufficiently non-actinic. No. 9 fogged—door of ditto not light-tight. No. 10 fogged—catch of dark slide not turned, and shutter partly withdrawn after removing from camera. Nos. 11 and 12 fogged—lid of plate box accidentally left open. He thinks by this time he knows a little about the

cause of light fog. Yet another method of fogging a plate was "brought to light" by the writer some time since: many miles from home, first plate just exposed, photographer discovered endeavouring to push back the shutter of dark slide—won't go—stuck fast; deliberate. Ah! small plate, must have slipped off pins of dark slide, fallen forwards, thus stopping shutter from closing; nothing for it but to sacrifice plate and remove dark slide from camera with shutter withdrawn; "crushed again!" dark slide won't part company with camera—one end of plate fallen forwards and *resting on camera back*; what's to be done? Eleven more plates to expose, camera rendered useless. Happy thought: remove lens and push back plate with stick; 'tis done. Success at last! (Plate, of course, fogged.)

Colour Fog.—We next come to chemical fog, or what is better known as colour fog. This is caused by an error in the preparation of the emulsion or in drying the plates. The mildest form of colour fog appears green if the negative be held over some dark object and examined by reflected light, and slightly pink by transmitted light, especially in the shadows, or under-exposed portions. This degree of colour fog, although very disagreeable to see in the negative, is of little or no detriment to its printing qualities, but in its more aggravated form it assumes a red or ruby colour by transmitted light, and being non-actinic, the printing qualities of the negative are seriously affected. This disease makes its appearance most frequently when the alkaline developer is used, and more particularly when excessive forcing with ammonia is resorted to; it is never seen when the ferrous-oxalate developer is used: therefore, if the first few plates of a batch produce green fog, the ferrous-oxalate developer should at once be adopted. There is no absolutely certain cure, although Abney recommends treating the afflicted plate after fixing and washing with a ferric salt, and afterwards apply the ferrous-oxalate developer.

Central Fog, or Flare Spot.—This is a circular patch of fog in the centre of the plate; it is produced by a defect in the lens, and is most apparent when the negative was exposed with the lens facing the source of light. It may generally be overcome by slightly altering the position of the stop.

Frilling.—Next on our list of photographic troubles comes a defect, technically termed "frilling." Although frilling sometimes occurs during development, it more often makes its appearance in the fixing bath. Plates frill more readily in hot weather when hot solutions are used, or when very soft water is employed for washing the negative; it is due to failure in manufacturing the plate, and may arise from several causes, notably when the surface of the plate to receive the emulsion has not been thoroughly cleaned and is not free from grease or dirt, when unsuitable gelatine has been used in the preparation of the emulsion, or when the plates have not been dried in a sufficiently ventilated box. Frilling usually commences at the edge of the plate, the film does not adhere to the glass, but raises up in ridges, which, in some cases, gradually extend to the centre, and the film may sometimes be detached from the plate, placed on a larger sheet of glass, and while still under water, the ridges or frills may be smoothed down with a camel-hair brush; and, if luck favours the operation, the film will dry on the glass quite even, and be little worse for its change.

Blisters arise from the same cause, only, in this instance, the film rises from the plate in the centre, and not from the edges as in frilling. When blistering commences, the negative should be immediately immersed in methylated spirit, which will extract the water from under the film; after this treatment the negative will probably dry without any defect being perceptible. Frilling and blistering may be stopped to a great extent by placing the plate in a saturated solution of alum immediately after development and before fixing, if necessary.

Flatness of Image is due to over-exposure and necessarily shortened development. The image is thin, and shows a want of density in the high lights and clearness in the shadows. Sometimes it is advisable in cases of over-exposure to strengthen or intensify the image on the negative; this may be done by immersing the plate in the following solution, but intensification should never be resorted to unless the plate is otherwise worthless from over-exposure, as the results are never permanent and the negative eventually fades. Intensification must, of course, take place before varnishing. The negative is immersed in the following solution, which may be used over and over again:—

Bichloride of Mercury	½ oz.
Water	10 ozs.

In this bath the negative remains until the film has become bleached or whitened, which it will do in a very short time; the negative is then *well* washed and immersed in a bath of

Water	5 ozs.
Ammonia ·880, or Saturated Sol. of Common Washing Soda . . .	5 drops.

The film will gradually darken in this solution, and must be removed and thoroughly washed when it has regained its usual black colour.

Too Great Density of Image has an exactly opposite appearance to the last-named defect, and is caused by over-development, or under-exposure—or both. The negative if too dense all over from over-develop-

ment, should be immersed (after fixation) until it is sufficiently reduced in the ordinary fixing solution, to every ounce of which has been added six or seven drops of

Water	1 oz.
Potassium Ferridcyanide	22 grains.

When too dense in the high-lights from under-exposure, the image can be reduced locally by painting over the parts with a camel-hair brush dipped in the above solution ; care must, however, be taken that none of the solution runs down the film.

Pin-Holes are very small transparent holes in the film, and generally occur in large numbers. They are caused either by a defect in the plate or dust having collected on the film before exposure ; they must be filled in to proper depth with Prussian blue.

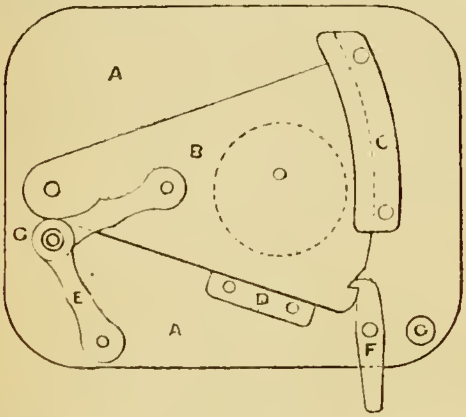


FIG. 29.—INSTANTANEOUS SHUTTER—ELEVATION.

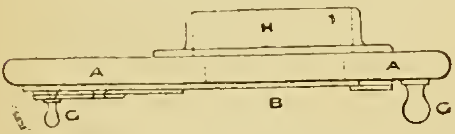


FIG. 30.—INSTANTANEOUS SHUTTER—PLAN.

Small Transparent Rings are caused by air bubbles forming on the film during the process of development, and are probably caused by too little solution being used, or having being poured over the plate with a splash. These, and any other transparent marks that may occur, must be touched out with Prussian blue.

Halation is a defect caused by the back of the glass plate and the particles of the silver salt reflecting back at an angle very bright rays of light, and causing a kind of fog or halo round the brightly illuminated image. It is most particularly apparent in photos of interiors, when windows are shown with a halo apparently extending to several feet all round them. This defect can be prevented to some extent, by "backing" the plate prior to exposure. Before being placed in the slide the back (glass side) of the plate should be covered with a coating of dark paint, such as Brunswick black, which prevents the reflection from the back ; the backing must be removed from the plate before development.

Several other minor defects "too numerous to mention," at times occur, and are due to various causes. A query in "ours," and, if necessary, the negative forwarded to me through the Editor's hands, will elicit the cause and remedy, if there be one.

When the amateur has succeeded in producing satisfactory pictures of still-life, he may turn his attention to moving objects, and enter into a most

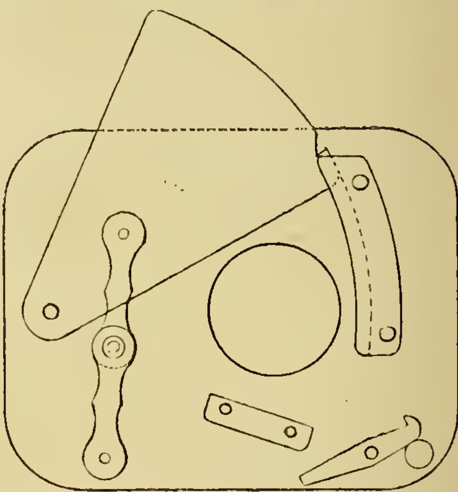


FIG. 31.—DIAGRAM SHOWING SHUTTER RAISED.

fascinating branch of our art : Instantaneous Photography. For this he will only require over and above the ordinary field apparatus, an instantaneous shutter and extra sensitive plates. An instrument for attaching to the camera to show when the moving object occupies the centre of the plate, and termed a "finder," is also a useful, but not essential, addition to the usual kit.

An instantaneous shutter is an instrument used in place of the cap when the subject is to receive a so-called "instantaneous" exposure. It should be so constructed that the length of exposure may be varied; one that will give an exposure from one-fifth second to one one-hundredth second, is quite sufficient for ordinary subjects ; it should also be so made that the foreground receives a somewhat longer exposure than the sky, so as to give objects near the lens full exposure, yet not over-expose the sky and distance ; by this arrangement clouds are obtained on the negative and give the picture a much more artistic appearance ; and, it must also be free from all vibration during exposure. I see no reason why the amateur should spend upwards of a sovereign on

a shutter when he may, with a little ordinary skill, construct one for a fifth of that sum, which will answer every purpose required of it. I give drawings, half full size, for half-plate lens, of an ingenious little shutter, which is very easily made, and a sketch in perspective of the popular drop and flap form of shutter. Of the former, little description is needed beyond an explanation of the illustrations. Fig. 30 is a plan of the instrument; Figs. 29 and 31 show the front or elevation of the shutter, with the rising part closed before exposure and open during exposure, respectively. A A (the base) is a piece of wood about $\frac{1}{4}$ inch thick, with a circular opening the size of the lens hood at O. B is a piece of vulcanite $\frac{1}{8}$ inch thick, which acts as the exposing part, or "flap," as it is sometimes called; it works on a screw as centre at the narrow end, and at the other end under a vulcanite guide C, which prevents it springing away from the base-board. D is a vulcanite "stop," which is fixed to A to prevent B from proceeding too far on its return after exposure. E is what is termed a "toggle" joint—two narrow pieces of brass joined together at one end with a brass knob G; the other end of one is attached to B, and the other to A; all three pins must be allowed to work freely. F is a brass release catch, or "trigger," working from the centre on a screw; one end fits into a notch in the edge of B, the other end hanging off the board A, so that it may be easily knocked away with the finger. G, G are two brass knobs; one is attached to the centre of the toggle joint, the other to A in one corner, as shown in the drawing; H (Fig. 30) is the brass flange for fixing the shutter to the hood of the lens.

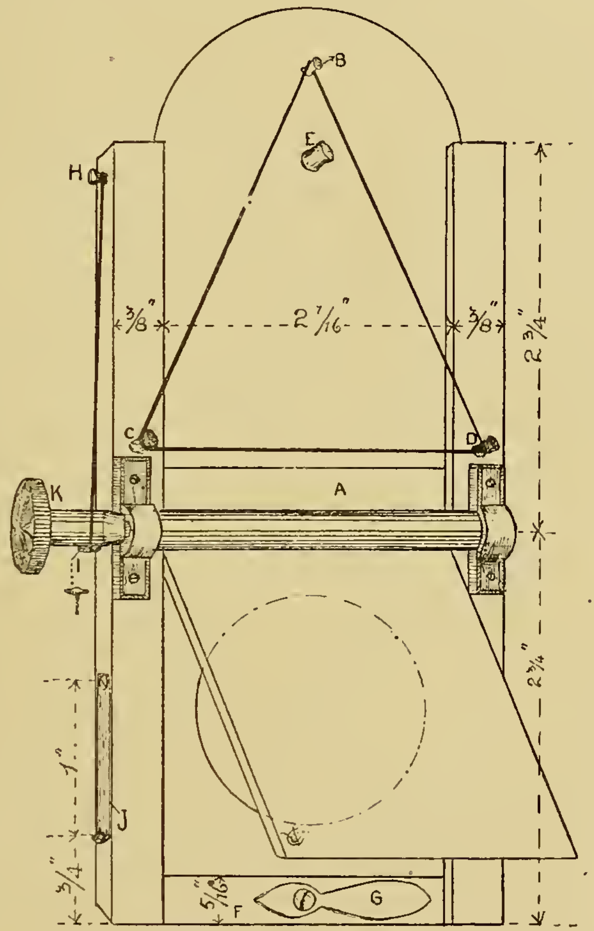


FIG. 32.—ANOTHER FORM OF INSTANTANEOUS SHUTTER.

The action of this shutter is very simple: the flap B is secured with the release catch, an elastic band is passed over the two knobs G, G (the rapidity of the exposure is regulated by the strength of the elastic band: by wrapping it once or twice round one of the knobs the exposure is wonderfully accelerated). A touch of the finger knocks the brass catch on one side and releases the flap, the elastic band draws the knob attached to the toggle joint towards the other knob, at the same time raising the flap until the two levers form a straight line, when the flap will be opened to its fullest extent (Fig. 31), the motion continuing causes the joint to form an angle this time at the opposite side to its first position; this action causes the flap to descend until it falls against the stop, again covering the opening. It will be seen that the bottom of the opening, through which pass the pencils of light from the foreground, is uncovered for a much longer time than is the top, through which the rays of light from the sky pass.

The next shutter (Fig. 32), although somewhat larger in size, has its advantages over the last-mentioned; in the first place, for reasons which the reader will see if he carefully examines the various positions of the base of the flap of the other shutter as it rises over the opening, the exposure is more equally and theoretically distributed. With this, as in the former shutter, the foreground receives a longer exposure than the sky, but here the bottom of the flap as it rises, and the drop as it falls, is always parallel with the base of the plate; while, in the other, the bottom of the flap is, during nearly the whole of the exposure, at an angle with the base of the plate: this

defect is practically of little consequence, as it makes no material difference with all ordinary work. The other advantage in this shutter is that it may be used for slow exposures and worked by hand, the flap (which is attached to the brass spindle running midway across the shutter) being raised by the milled head, and also acting as a shade for the lens during exposure. I cannot here describe the construction of the shutter at length, but I think the drawing almost explains itself. The shutter should be made throughout of vulcanite, it measures (for half-plate size) $5\frac{1}{2}$ inch high, by $2\frac{13}{16}$ wide; the drop portion is $3\frac{3}{4}$ by $2\frac{3}{16}$ inch, just large enough to work in the grooves at the side without friction, a strip of vulcanite, A, about $\frac{5}{16}$ inch wide is fastened to the bottom, and a notch is cut at the left side $\frac{3}{4}$ inch from bottom, into which the spring, which is shown at the side, presses a pin when the drop has fallen, thus preventing it from rebounding or being accidentally raised; a small button or knob, B, is fastened in the centre and about $\frac{3}{8}$ inch from the top, over which an elastic band is passed from two other buttons C, D, at the sides; another and larger knob E, round which is fastened a stout piece of rubber, is placed $1\frac{1}{16}$ inch from the top; as the drop falls, this strikes against the spindle and prevents the drop stopping with a shock. The flap is secured to the bar, and is made to fit between the sides $2\frac{1}{16}$ wide and $2\frac{5}{8}$ inches long. A strip of vulcanite, F, $\frac{5}{16}$ inches wide is fastened to the bottom of the shutter, and to this is screwed the release or trigger, G. Another button, H, is placed near the top at the side, and from this an elastic band passes round the bar to a brass button I, at the back, this gives additional speed to the shutter, and also assists in raising the flap. An increase of speed may be gained by wrapping the band round the bar.

The action of the shutter is as follows: The elastic bands are secured, the spring, J, is lifted with the finger-nail, the drop is raised, and the flap is shut down and secured with the trigger. The drop then rests on the top of the flap, and cannot fall until this is removed. Exposure is attained by knocking the trigger on one side, the flap rises, and when at right angles with the shutter releases the drop which immediately falls, with more or less rapidity, according to the strength or quantity of the elastic bands, and closes the exposure.

To expose "by hand," the flap is raised by the milled head K, until nearly horizontal; the exposure is then timed, and the flap raised a little higher when the drop falls.

Mr. R. Melhuish and Sons, *Fetter Lane, E.C.*, inform me they can supply $\frac{1}{8}$ inch vulcanite, in sheets of 2 feet square, at 5s. 6d. per lb.; the amateur will have little difficulty in cutting this to any shape with a fret-saw. Mr. A. A. Pearson, 44, *Queen's Place, Leeds*, sells the whole of the brasswork (including flange for lens hood) for the last shutter, ready for attaching to the vulcanite, and sends it by Parcel Post for 3s. 6d.; and, I have no doubt, he would be glad to supply brasswork for the other shutter at an equally low figure. The following is a detailed list of the brasswork, with Mr. Pearson's prices attached to each: half-plate velvet-lined flange, 1s. 6d.; spindle, drilled and screwed, 6d.; milled head, 6d.; pair bevelled bearings, 6d.; finished catch, 2d.; 6 screws, 2 studs, and eyes for elastic, 6d.; spring catch, 2d.

With respect to quick plates, Edwards' "X L" 4s. 6d. per dozen; and Leather, Sadler, and Holm's "Alliance," 3s. 9d. per dozen, are the most rapid in the market. Edwards' yield the richest pictures, are coated on good glass, and are packed in grooved boxes, but I have also found the "Alliance" excellent and reliable plates.

Seascapes form the most effective subjects for instantaneous photography, and are, perhaps, the easiest to take. The surging sea with the waves breaking upon the rocks, one or two small figures dabbling in the water in the foreground, in the mid-distance a yacht, steamer, or group of fishing-boats, and, perhaps, a jutting headland with lighthouse or white-washed cottages, other ships on the edge of the horizon, large fleecy clouds above with, peradventure, the sun peeping out from behind one in the extreme right or left, and forming on its crest a beautiful golden streak of light, which will contrast advantageously with the darker portions of the cloud, are all marvellously portrayed by the aid of drop shutter and quick plates, and will combine to make a most charming and attractive picture. Landscapes, with moving objects, waterfalls, lake and river bits, street scenes and the like, are very suitable for instantaneous exposures; for street views, however, the day should be very bright, and the lens and plates very rapid, as the objects—buildings, figures, drays, etc.—are nearly all dark, and require comparatively longer exposure, or, what amounts to the same thing, quicker plates and lens. Express trains, foot and horse-races, genre pictures, etc., may, under favourable circumstances, be taken instantaneously.

The manner of fixing up the apparatus, focussing, etc., is exactly the same as for slow exposures. If the object that is to form the principal part of the picture be invisible at the time of focussing—if it is a moving object that has to pass rapidly in front of the camera from one side to the other—the amateur must judge to the best of his ability the place where the object will pass, and focus some stationary object near the spot. After focussing, instead of putting the cap on the lens, the instantaneous shutter takes its

place, with the elastic bands secured and adjusted, according to the amount of exposure the subject is to receive, and the flap held in position over the opening by means of the brass trigger. The stop required for instantaneous pictures is generally the largest or open aperture, but, sometimes, for well-lighted marine views, the next size smaller may conveniently be used. When the proper moment arrives the trigger is pressed, a sharp click is heard as the drop falls against the stop, and the plate is ready for the developing dish.

Development is almost the same as for ordinary exposures, but I strongly recommend the amateur to use the potash solutions, and a long and patient development; this will produce good results from considerably under-exposed negatives, and does not stain the film like ammonia. Do not attempt to force development, but let it take its own course. If the image does not appear in five minutes a few drops of the potash solution may be added, and, during development, a little more will do no harm.

A few words on snow scenes before concluding the present chapter. When snow is on the ground and trees, pretty and effective pictures may sometimes be obtained; and a view which looks very ordinary will often look charming when the ground is thickly covered with snow and the trees resplendent with hoar-frost. Snow bits are, however, very difficult subjects to manage successfully, and the beginner generally—always, I may say—errs on the side of over-exposure. Snow scenes require but a wonderfully short exposure, which should be calculated as for a bright summer day. The reason of this extra actinic power should be obvious to everyone; the light which is usually absorbed to a great extent by the ground, trees, etc., is reflected when these are covered with white, mirror-like flakes of snow. A snow subject always looks best when the sun is shining, so as to make light and shade, where, otherwise, it would seem excessively flat. With faint sunlight, *small* stop and ordinary plates, a "cap off and on," exposure is generally sufficient. Use a slow developer and *plenty* of bromide.

The three pictures in the Folding Sheet were reproduced direct from photographs by photo-zincography, but, unfortunately, much of the beauty and detail of a photograph is lost by the grain necessary for typographical printing. The first illustration is a bit from Yorkshire, typical of English rural scenery. The portrait, taken in an ordinary room, proves that satisfactory portraiture is not attainable in the professional's glass room only. The third picture was taken at dusk with one of Fallowfield's "Original" Guinea sets.

(*To be continued.*)

PRACTICAL SCENE-PAINTING FOR AMATEURS.

By HENRY L. BENWELL.

XVI.—STREET SCENES (*continued*).

THE illustration of a street given in the last chapter is adapted for a back cloth only, as previously mentioned. I therefore give another drawing (Fig. 83) suitable to use midway on the stage, which is also a specimen of angular perspective, and which I shall refer to later on. It is, moreover, what is known as a "local" scene in stage "parlance;" these scenes I will speak of presently. The other drawing which accompanies this chapter is designed for use in the front grooves only, and I will draw attention to this (Fig. 82) first, as requiring the most description.

This class of scene, as is pretty well known, is generally required in the harlequinade of pantomimes. They are, however, in these cases painted more "life-like," *i.e.*, with goods, etc., exhibited in the windows (which are often practicable), the articles of trade being mostly "properties," some, however, being painted on the scene. For "comic scenes" (as these are sometimes called), a "cloth" is not used as a rule, the substitute being a pair of flats dividing in the centre, and running on and off from each side. These, of course, run in the "grooves" overhead, and are sometimes mounted on castors or wheels. Flats are used, I may say, because it is necessary for the doors, etc., to be practicable, and also for the insertion of "leaps," tricks, and other novelties. The "leap" is an opening or sort of trap in the scene through which the harlequin suddenly jumps and disappears, first through a pane of glass, next through a door, and again through a brick wall, and so on. These traps are in most cases about 4 feet 6 inches from the floor of the stage, some are higher, according to the agility and cleverness of the actor. Years ago, when clowns and harlequins were really clever at their business, these openings were nearly all over the scene. A leap is 24 inches square, and consists of a strong framework of wood, which is firmly fixed to the outer frame and cross-pieces of the flat—in fact, forming an integral portion of it. The frame is about 2 inches thick, in order to bear the leaper's weight when he puts his hands on it in passing through.

The panel or trap which fits into the opening is crossed and re-crossed several times with webbing and canvas, so that when the harlequin's head comes into contact with it, he neither damages the canvas nor hurts his head. They are hinged at the top, and behind is sometimes a weak spring to force the canvas door quickly back to its place as soon as the

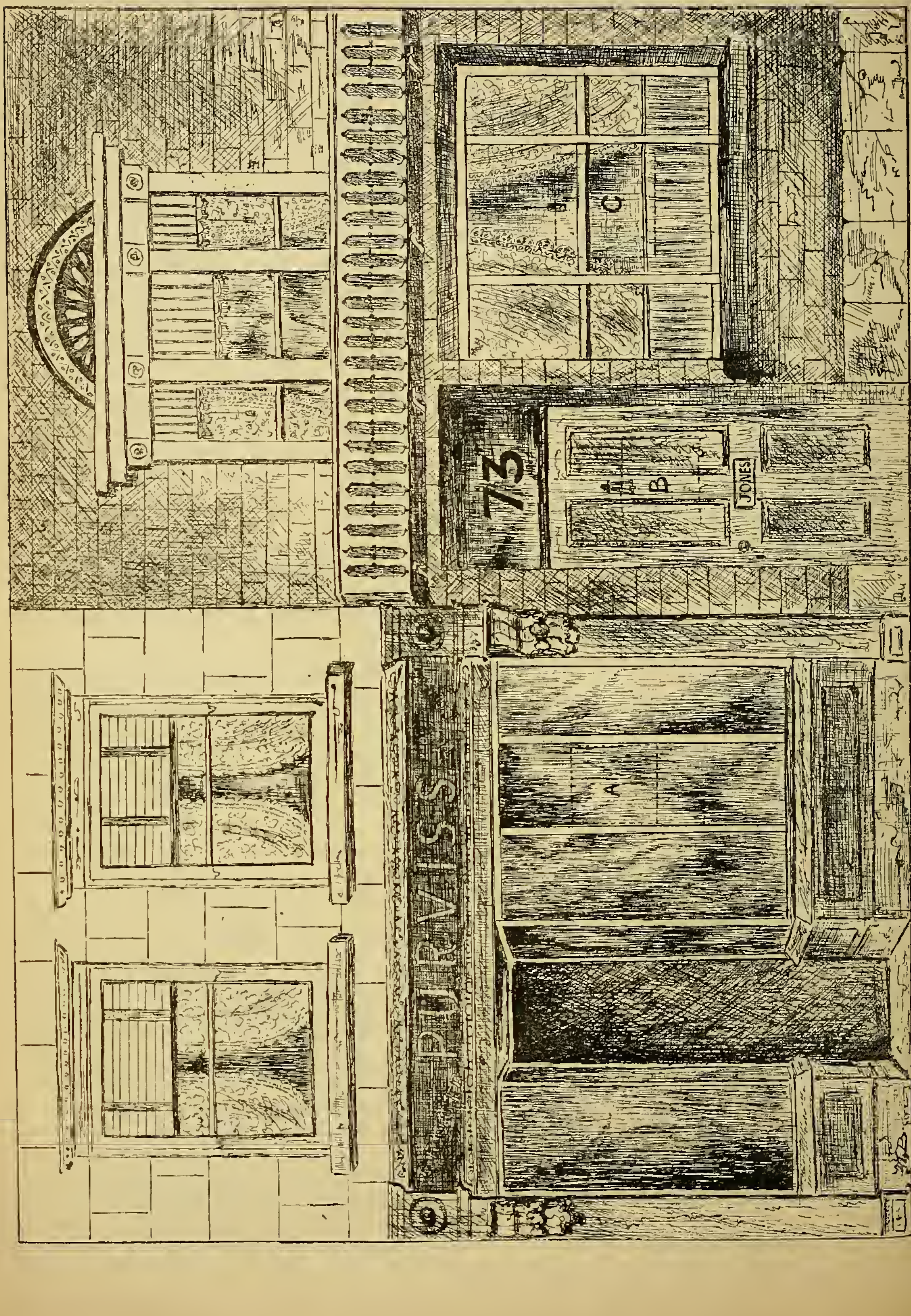


FIG. 82.—STREET SCENE, SUITABLE FOR HARLEQUINADE OF PANTOMIMES.

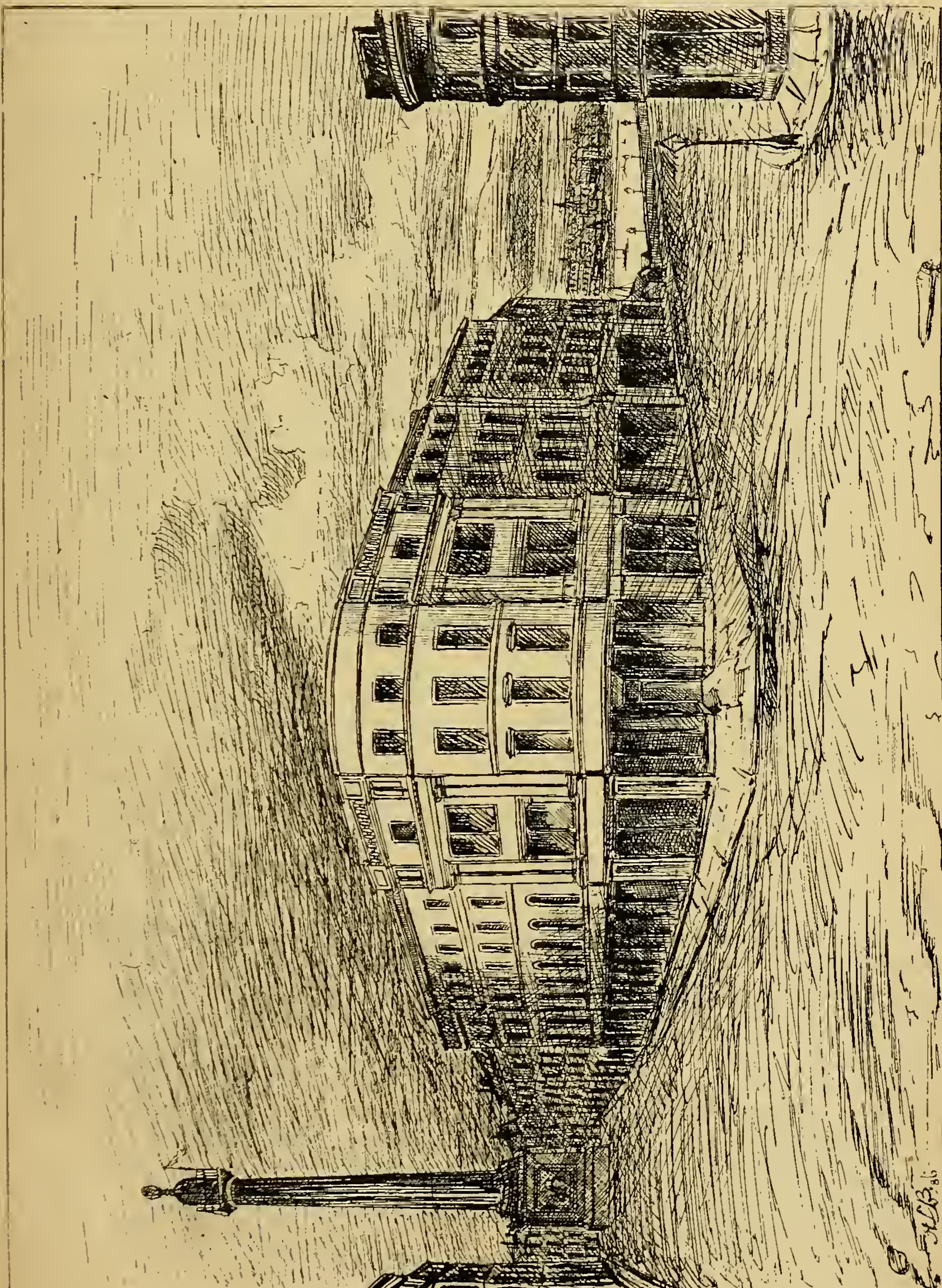


FIG. 83.—EXAMPLE OF "LOCAL" SCENE.—APPROACH TO LONDON BRIDGE AND MONUMENT—TO BE USED MIDWAY ON STAGE.

leaper has cleared it. The dotted lines at A B C, in Fig. 82, are leaps, and, when closed, should properly be invisible at a distance. There are a great many other openings and devices in these scenes; but the various tricks of Messrs. Clown and Harlequin must await their proper place in the property department. I should mention that when these leaps are used, the flats must be placed considerably further up the stage than the front grooves.

This rough design may be used as a back scene in the harlequinade, and, if wanted as a comic scene take away the private door and window on the right and turn into a butcher's shop with open window and name-board above.

For use in an ordinary drama or other piece, the present design must only be used in front grooves, and for a modern street, otherwise it would look ridiculous. The front of a railway station, police station, bank, club, or other public building may be painted after this fashion; and if "flats" are used, practicable doors may be made with portable "backings," so that they may be opened whilst the scene behind is being changed.

I should like my readers to understand that Fig. 82 can be painted on, and used as an ordinary "cloth" on rollers, and will prove a handy little scene for the amateur stage. I will give a pair of side-wings to match later on if I can possibly find room for them.

I have very little to say concerning Fig. 83, as the design speaks for itself. I shall, however, refer back to it in the next chapter. It will be noticed that the light and shade are very good in this drawing; the perspective is good, and it is a class of scene that most country managers would use at a push in any piece, and on any part of their stage if it were required.

I should like to remark that the illustrations, Figs. 82 and 83, are taken direct from my drawings by the process known as photo-zincography. As this is the first time I have made drawings large enough for this method of illustrating my work, I trust it may prove successful, and enable me in the future to convey to my readers my meaning with my pencil as well as with my pen.

In concluding the remarks on Street Scenes I would draw attention to an old English street which appears in the "Journal of Decorative Art," for June, 1886. It is a magnificent subject, was drawn from the artist's stage model, and is a photo-zinco direct from the drawing, the same process I have just mentioned. There are also drawings of an act drop and two other stage pictures which might prove useful to the readers of AMATEUR WORK.

(*To be continued.*)

MAP COLOURING, MOUNTING, ETC.

By JOHN BRION, Constructor of Relievo Maps to His late Royal Highness the Prince Consort, Author of the "Construction of Relievo Maps," the "Renovation of Paintings," etc.

I.—DIFFERENT KINDS OF COLOURING—MATERIALS REQUIRED—PREPARATION OF THE MAP—COASTING—OUTLINING — FLATTING-IN — RULES FOR HARMONY OF COLOURS—EXAMPLE BY A MAP OF PALESTINE.

THE art of map colouring is a very simple one, and with the knowledge of a few rules, moderate practice, and a little taste, proficiency may be speedily acquired, not merely that of the amateur, but such as will enable those who desire it to augment their income, or obtain a very respectable subsistence by practising the art professionally, for the map publishers, in London alone, have some hundreds of colourists in their employ. More of this anon.

Maps may be classed in three groups: 1. Terrestrial and Celestial; 2. Seamen's Charts; 3. Plans of estates and buildings. There are also three different kinds of colouring: Pencil (*i.e.*, brush-work), stencil, and lithographic. We will begin with pencil-work.

The materials required for the practice of this branch of the art are few, simple, and cost but little.

1. About a dozen water-colours.

2. A set of camel-hair or sable pencils, *vide* illustration.

3. A basin and a glass tumbler to hold water.

4. Two pieces of fine soft sponge—one of the size of a walnut, the other as large as an ordinary orange.

5. A dozen plain small white saucers.

6. A four-ounce bottle of liquid ox-gall.

7. A few sheets of stout white blotting-paper, and some of white writing-paper.

(1.) The cheapest and most useful water-colours for ordinary use are those sold in small tin pans, 1d. each, by Messrs. Reeves and Son, *London*. They are called "moist water-colours," and can be procured at nearly all stationers. For very superior work the water-colour cakes of Winsor and Newton, Rowney and Co., Barnard and Sons, Artists' Colourmen, *London*, will prove to be all that one can desire. The colours we would recommend are: Crimson lake, burnt sienna, burnt umber, cobalt blue, Prussian blue, indigo, gamboge, Roman ochre, brown pink, Hooker's green, green bice, sepia.

A beautiful crimson colour, easily worked, and very permanent, can be produced by dissolving powdered carmine in spirit of ammonia. This may be diluted with water to suit your purpose when using. Keep the bottle containing the colour well corked, or it will speedily evaporate. Gamboge, in

the lump, as hought at the chemist's, will give a pure yellow not excelled by the cakes of the best makers, and it costs not more than a quarter the price of those. Nearly every tint of green can be produced by mixing gamboge with Prussian blue or indigo in varying proportions. If a sober green be needed, tone down with umber, burnt sienna, or sepia. A few experiments will teach you all that is needed. Any chemist will supply you with the powdered carmine, spirit of ammonia, and a lump of gamboge. Threepennyworth of each will enable you to colour a great number of maps. Very useful stains for flatting-in can be made by steeping tea, coffee, tobacco, oak-bark, saffron, onion skins, etc., in hot water. Bottle off the decoctions when made, add about a tablespoonful of any ardent spirit to half a pint of decoction, or it will soon become mouldy and thus be spoiled. Keep well corked till you wish to use it.

(2.) Sable pencils are greatly superior to camel-hair, both in elasticity and durability, their price alone prevents them being more generally used; the difference in cost is from four to six times upon that of camel hair. But though so much dearer at first, their greater durability has shown them to be the cheapest in the end, to say nothing of the gain in certainty of touch and in speed that attend their use. The following sketch will show the relative prices of the two kinds, and also serve for reference in our instructions.

(3.) Keep your basin, glass, and water scrupulously clean, the slightest touch of grease will give you infinite trouble, and muddiness of water will ruin the best of colours.

(4.) Hard or coarse sponge is likely to roughen your maps, and thus make your work ragged and blotchy. Keep your sponges very clean.

(5.) Plain white saucers, of about two inches in diameter, will enable you to keep your colours separate and pure, and serve quite as well as the more expensive slabs and dishes of the artist.

(6.) Ox-gall can be purchased at the butchers at about 2d. or 3d. for a four-ounce bottle full. The disagreeable odour of the gall may be dispersed by putting two teaspoonfuls of solution of chloride of zinc into four ounces of gall. Shake the bottle well; leave it uncorked in the open air for an hour, then cork down. The solution of chloride of zinc is the same as Sir William Burnett's disinfecting fluid. *Remember it is poisonous.* Little jars of solid ox-gall, inodorous, may be obtained of the artists' colourmen, price 6d. and 1s. each, but I greatly prefer the liquid ox-gall prepared as I have recommended.

(7.) White blotting-paper is sometimes useful for absorbing superfluous water or colour. A piece of white calico, doubled, will answer the purpose as well, and is far cheaper and more durable. Writing-paper will supply you with a ready means of testing your colours or the condition of your pencil.

Suppose that you have the foregoing articles ready at hand let us proceed to colour a map. Unless there be many copies to work upon, or the map is of very large size, an ordinary table will serve for a bench. Assume that our first course of practice shall be upon a dozen quarto maps of ancient Palestine. We have selected this country as being one of the simplest in outline, yet affording sufficient variety of divisions to exercise the pencil and show the effects of contrasts of colour.

Cover your table with clean paper or calico. Lay your maps at your left hand in a little even pile, faces upwards. Put about a pint of cold water into your basin, and pour into it two teaspoonfuls of ox-gall. Stir the mixture with a piece of clean wood or bone, which should be kept for the purpose. Saturate your large sponge with the water, and squeeze out till about half dry. Take the uppermost map from your left hand pile, place it in front of you, and gently and quickly pass your wet sponge over the whole of face of the map. Be careful not to soak the paper or to leave any superfluous moisture thereon; if you should do this, lay a sheet of blotting paper upon the map, absorb the water quickly, and lay it face upward at your right hand. This done, take a second map from your pile, damp it in the same manner as the first, and deposit it upon the one that is at your right hand. Proceed thus till the dozen have been damped and your little pile transferred from your left hand to your right. *Note.*—The damping with the ox-gall and water removes any greasiness that may have been communicated to the maps by printing. It also renders the paper more fitting for the reception of colour.

Coasting.—This is a technical term given to the producing of a softened water-line upon that part of a map which represents the sea-shore, *vide* the line A B C upon illustration Fig. 2. This is somewhat delicate work, and requires a little tact; we recommend our readers to take some practice on a blank piece of paper before proceeding to the map; in order to do so prepare your colour thus:—

Fill your tumbler with pure water, and place it at your right hand. Take Prussian blue, and if it be the "moist water-colour," cut from it, with a penknife, a piece of about the size of a small pea. Put this into one of your little saucers with about a teaspoonful of water. Rub the colour down in the water with a small bone spatula—a bone mustard-spoon serves well for the purpose. Add more water till you obtain the proper tone of colour, which should be about the depth of what is termed "Cambridge blue."

Select two of your brushes, Nos. 3 and 5, and charge No. 3 with the blue colour, but see that this is not in a dripping condition. Fill brush, No. 5, with water. With brush, No. 3, draw a blue line from A to C ; cut clean to the coast, making the line about half an inch wide, and seaward. Do this as quickly as you can, then with your brush, No. 5, draw a water-line just touching the outer edge of the blue line, parallel to it, and of the same width. If your blue line has been quickly and properly done, the outer edge of blue colour will gradually blend into the water-line, and produce a pleasing softened effect. Quickness and accuracy in drawing your lines, with "just enough and not too much" of colour and water, are the chief points to be studied; with these, and a little practice, you will soon acquire facility. If your endeavours do not satisfy you, erase your work with your small sponge and a little water, then lay the map aside to get nearly dry; but the fewer erasures you have the more satisfactory will be your work. After coasting your map, do the same to the three lakes, D, E, F, *vide* illustration, Fig. 2, making the blue lines there much narrower. Coast the whole of your maps in this manner, and lay them as you do them on your left hand, but do not pile them one on the other, as the wet colour may be transferred or blotted. In some maps the coast line is shaded with waved parallel lines softened off towards the sea, but whether thus shaded or left in outline, it is usual to coast with softened blue as we have described. If you use hard cake colours you will have to rub your colours down in water. To do this put half a teaspoonful of water into one of your saucers, and in it rub one end of the cake in a circular motion till you obtain a sufficiency of colour, then dilute with water to the required tint. We can now proceed to outline the divisions of the map.

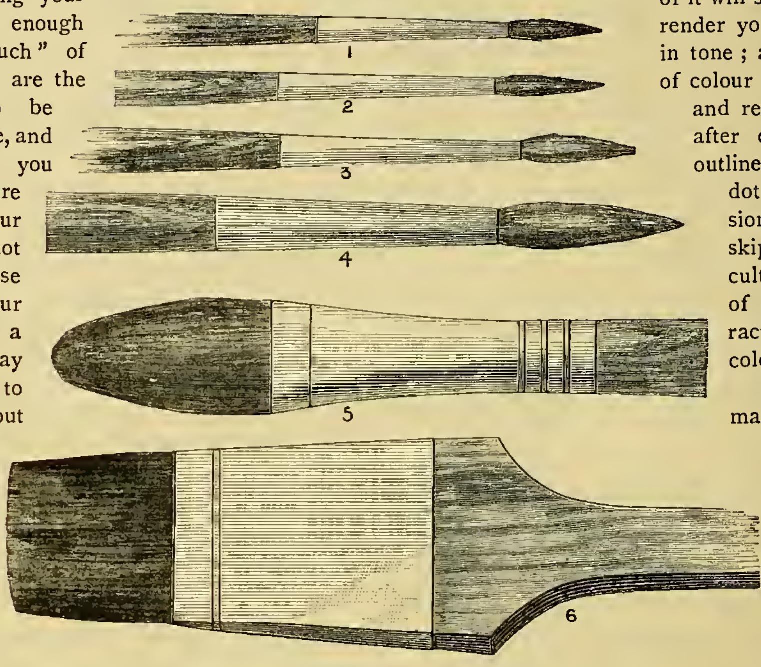


FIG. 1.—BRUSHES USED IN COLOURING MAPS.

1, Duck ; 2, Small Goose ; 3, Extra Goose ; 4, Small Swan ; 5, Water Brush ; 6, Flatting-in Brushes. Prices : 1 to 4, Camel-hair, 2d. to 6d.; Sable, 6d. to 2s. ; 5 and 6, Camel-hair, 1s. 6d. ; Sable, 5s.

Prepare gamboge in a saucer as already directed, taking care that while the colour is not too thick, that it is decided in tone. This remark will serve for all colours. Take pencil No. 1, charge it with the yellow colour, and around the boundary of divisions Nos. 1 and 10, *i.e.*, Asher and Reuben, draw clear, even lines of about this width ———. Do each of these divisions at one movement of your brush, if possible, and keep the line of an equal breadth throughout ; retouching or patching generally produces raggedness in effect. *Note.*—Keep your colour stirred with your brush from time to time, or it will subside, and thus render your work unequal in tone ; also keep plenty of colour in your saucer, and retain what is left after completing your outlines. Follow your dotted lines of divisions accurately ; skipping over difficult curves is one of the chief characteristics of a bad colourist.

Colour all your maps with yellow in divisions Nos. 1 and 10, then prepare your green, and with it outline, in all the maps, divisions Nos. 5, Gad ; and 11, Simeon. We will take sepia next. This is a very agreeable neutral colour, especially if mixed with a touch of lake ; with it let us outline Nos. 12, Zebulun, and 2, Benjamin ; crimson lake for Nos. 9, 4, 6, Naphtali, Ephraim, Issachar ; burnt sienna for No. 8, east, and No. 8, west of the Jordan, *i.e.*, two half tribes of Manasseh, and Judah No. 7 ; with Roman ochre for No. 3, north and south, two portions of Dan, we shall complete our outlines. The following classification will perhaps assist the reader in his work : Yellow for 1, 10 ; green for 5, 11 ; sepia for 12, 2 ; lake for 9, 4, 6 ; sienna for 8, 8, 7 ; Roman ochre for 3, 3.

It has doubtless been noticed that we have avoided colouring any outline that touches another immediately after the first is done. This is to prevent

one colour from running into another, and should always be remembered.

The tribal divisions being outlined, our next attention will be given to the boundaries of the adjacent countries. Here, again, we shall use a softened line, as in the "coasting," but of a different colour. For this, prepare either carmine or crimson lake, and with it draw a line a quarter of an inch wide, beginning at L in the north, and proceeding on the dotted line eastward to G, and thence south by H, I, J, K, K, using your softening water-brush with your left hand as you colour with your right, if you can; otherwise you must colour the boundary in portions, and soften-off as you proceed.

Many maps are left in coloured outline, but some publishers and purchasers prefer to have them full-coloured. This is obtained by a very simple process termed "flatting," and is thus effected: Take the saucer containing the remainder of your yellow outlining colour, dilute this with water to form a wash of about one-third, in tone, the depth of the outline. Fill your "flatting-in-brush," No. 6, with the wash, and with it go quickly and evenly over the divisions which have been outlined in yellow, *i.e.*, Nos. 1 and 10, using one of your smaller brushes, if you need it, to lead the wash up to meet the coloured outline. Be careful to cover every part of the division evenly; use plenty of the wash or your work will be streaky, and remove any superfluous wash by "driving it into a corner" with your brush, and then absorb it with a dry pencil. The washes should be laid on in the same order as the outlines were, and the rule for yellow will apply to the other colours. Suppose them to be satisfactorily done, we will proceed to the last step in our task—namely, the tinting of the adjacent boundaries.

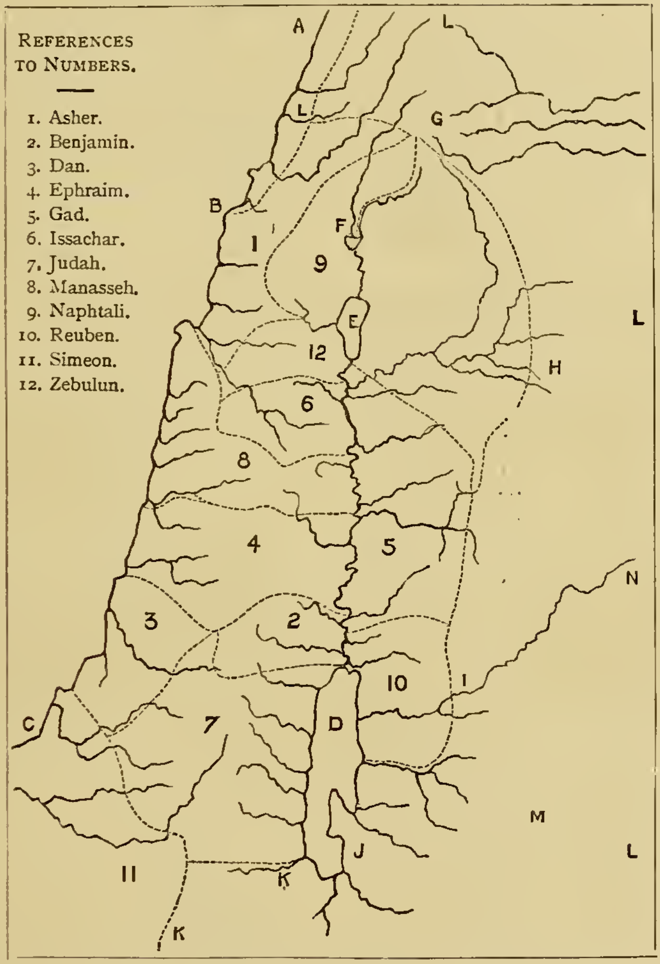


FIG. 2.—MAP OF PALESTINE, ILLUSTRATIVE OF METHOD OF COLOURING.

Let the work be ever so skilfully done, maps coloured either geologically or politically, are open to the objections of being inartistic and unnatural; but maps coloured according to the general appearance of the lands they represent, may be made very pleasing. The greys of the mountains, the verdure of the plains and valleys, the golden hues of the arable, and the sombre tones of barren or desolate districts, may be wrought into an attractive picture. The maps in Stanley's "Sinai and Palestine" are coloured upon this principle, and though the poorness of their execution has led to their being condemned, they deserve praise for having exhibited a natural idea. In dealing with the countries bordering on Palestine, we may, in some measure, follow the same principle for the mountains of Lebanon on the north; the plains of Damascus, north-east; the table-lands of the Hauran, eastward; the broken mountain region of Moab, merging south-eastward and south into the sands of Arabia and the Desert of Idumea, give a very fair scope for the exercise of taste and judgment. This region is usually coloured in one sober tint, meaning anything or nothing. We would say to our readers that, unless you are working from a "copy" (which it is the practice of publishers to "give out" with their work), dare to be a little natural, and in the case of the map of Palestine, which we have supposed you to have in hand, colour the plains of Phœnicia A, B, *vide* Fig. 2, with a bright green,

blending it into a pearly grey over L, L, G, for the mountains of Lebanon ; soften this into a somewhat darker green at the sources of the rivers L, G, and carry the green east and south over the space L, G, H, L, marking the great plain of Damascus. Work a tone of warm brown (umber) from H, L, I, following the course of the river as a boundary. This will indicate the hilly district of Bashan. The triangular space I, M, J, may be done in sober grey to mark the mountains of Moab, and the desolate region east of the Dead Sea. The remaining space south of N, M, J, K, K, should be washed in with Roman ochre, to accord in some measure with the tone of the Idumean Desert. Be careful to blend all colours into each other at their lines of junction—this may be easily done when your colours are wet ; if allowed to dry before doing this, the matter will be much more difficult. If there is nothing very artistic in the colouring we have proposed, at least we shall avoid some of the absurdities of the old methods.

The reader will, we think, now require instruction on only a very few points besides the preparation of the grey tints. For pearl greys, mix Prussian or cobalt blue with a small proportion of crimson lake. For other greys: Indigo with sienna, umber, sepia, or Indian ink. Practice with these on blank paper, and you will soon obtain almost any tint you wish for.

If you use carmine instead of crimson lake and make an error therewith, you will have to expunge it with solution of chloride of lime, as simple water has no effect on carmine. Prepare the solution thus : Put a teaspoonful of ordinary chloride of lime in a three-ounce bottle of pure water, cork down, shake well, and after a few hours shake again; do this several times, as the lime is not very soluble. In using, touch the spot you wish to expunge with the end of a bone penholder or a piece of white rag dipped in the chloride of lime, the colour will vanish immediately. Wash off instantly with clean water repeated two or three times, or the lime will attack and damage the paper. Never use brushes or sponges in chloride of lime or they will be ruined.

It will be well, after finishing your maps, to pile them as at first, and let them remain an hour or two under the pressure of a smooth piece of board weighted with books or something heavy; a towel-press is very useful here. Never dry your work by the fire nor in the sunbeams, or they will "cockle," *i.e.*, wrinkle in an unsightly manner.

We have in this article described what is known as "Atlas work." "Book-work," *i.e.*, maps to illustrate books, is done in the same manner. Wall and library maps, charts, globes, etc., with methods for mounting and varnishing, will be treated in our next paper.

(*To be continued.*)

THE REFLECTING TELESCOPE:
ITS CONSTRUCTION AND MANUFACTURE.

By EDWARD A. FRANCIS.

X.—THE POLISHING OF THE SPECULUM (*continued*).

WE will resume the subject of figuring : the art of communicating to the concave glass surface, the parabolic curve or figure. The reader will recognize during these experiments in testing, the effect of the air currents which rise twisting and twirling before the front of the mirror. It is impossible to avoid them in an ordinary apartment, but the experimenter will soon learn to disregard their presence, to look through them at the shadows on the illuminated surface of the speculum.

There is one other effect, too, which will be noticed during the earlier stages of the polishing, and that is the appearance of the emery marks, if the polish has not begun equally on the whole surface. These marks, at the beginning, form a valuable guide showing at once in what part of the speculum the greatest amount of action is taking place, and thus indicating whether the stroke in use is that proper for our purpose. A casual survey after the first few minutes' polishing, will render apparent which part of the concave surface of the glass has been most worn away.

It has already been pointed out that the shadows are reduced to three great orders—those of *a*, the oblate spheroid, Fig. 55 ; *b*, the sphere, Fig. 51 ; *c*, the hyberbola, Fig. 59, which latter includes the ellipse and parabola. A speculum *must* present one of those three appearances, disfigured with other irregular shadings it may be, but still being evident as the underlying principle. It is important to remember this ; for if, during the figuring, irregularities—central depressions, or narrow ridges—appear, the stroke may be slightly altered to remove them, but must still have for its purpose the maintenance (or correction, as the case may be) of the foundation figure.

Remembering that the curve at which we aim is the sphere (it is comparatively easy to form from a perfectly spherical mirror one that shall be parabolic), let us consider the general procedure of figuring.

Were we treating of the construction of any ordinary piece of mechanism, it would only be necessary to lay down a code of rules (based on the theory of the last chapter) and then adhere strictly to them, to have a certain result—the workman being only required to blindly follow those rules, without any especial exercise of his intelligence. But this is just what one cannot do in the figuring of the speculum, or the communication of a parabolic curve

to the mirror must ever be the result of deliberate individual reasoning.

It may be safely asserted, that if twenty amateurs were employed to construct twenty specula, of the score of curves so obtained before the actual figuring commenced, not two would be exactly alike, and, consequently, the process of completion would vary in each case.

One or two very general instructions may, however, be given as to the order of action to be adopted in the process of figuring a concave speculum.

(*a.*) Having brought the grinding to a high state of perfection, polish for half an hour with a stroke of about one-third of the diameter of the speculum. This will fit the surface for examination at the centre of curvature, and the stroke (one-third) is that best calculated to maintain the curve—the result of the grinding*—unaltered. The speculum may then be taken to the testing room.

At the first testing, practically made immediately the glass surface is at all brightened, it may be decided to which of the three divisions the rough figure communicated to the speculum belongs: upon that decision the rest of the working must be based, so that the curve of the speculum may from the beginning be kept well under control.

(*b.*) If, when first tested at the centre of curvature, the curve indicated be very distinctly hyperbolical (*i.e.*, if the shadows [Fig. 59] be very dark), the final fine grinding should be returned to for half an hour or so, working with very short strokes; for this hyperbolic curve is the most difficult to deal with, and regrinding with short strokes, is the most rapid method of correcting it to a spherical concavity.

But, if the shadows which indicate the hyperbolic curve be very faint indeed, so that the departure from the sphere is slight, the polishing may be proceeded with; the stroke, however, being immediately reduced until the curve becomes spherical.

It would be well to draw a full-sized section of the apparent solid (see previous chapter); then the best stroke to change the hyperbolic to a spheric curve would be one of a length equal to the distance from one end of the section line to the top of the ridge nearest that end. Several methods of drawing such a sketch will suggest themselves to the reader; a strip of common glass, for example, of a width equal to one-half of the diameter of the speculum, and divided by black lines into inches, etc., would, when rested against the illuminated mirror (the observer being at the centre of curvature), serve the purpose of a guiding scale.

(*c.*) If, on testing, the curve of the glass appears to be that of an oblate spheroid, Fig. 55, or of a sphere, Fig. 51, the polishing may be continued with the same (one-third) stroke. The amateur may congratulate himself on his skill, if he preserve either of those figures until the polishing has been completed.

From what has been just written, a fourth rule may be deduced.

(*d.*) To make a spheric mirror hyperbolic, lengthen the stroke: to make a hyperbolic mirror spheric, shorten the length of stroke.

So far, the rules are rigid; but no farther. From this point (for the amateur) there will be nothing but a constant resort to testing and the adoption of that stroke, which the result of each testing indicates to be the most suitable.

Here shall be extracted from the author's private notes, a rough record of the process of the completion of a speculum from the first testing; thus, the reader will have presented to him a typical procedure, which (although it is unlikely that his own speculum will require a similar course of treatment) will serve as a sample of the deliberate reasoning, by which the shadow test is made to indicate the requisite stroke.

The speculum in question was ground and polished in a manner identical with that described in these papers. It was formed of plate glass, polished on both sides, and was $1\frac{1}{2}$ inch in thickness. The diameter was $6\frac{1}{2}$ inches, the focal length $5\frac{1}{2}$ feet. The polisher was formed of best black pitch, and was divided into facets $\frac{5}{8}$ inch square separated by intersecting channels, the facets being arranged as in Fig. 35.

After the preliminary polishing, the speculum presented under test, an almost spherical figure, free from any irregularity (save that it was evident that the polish was incomplete), there being no dark unpolished patches of emery marks such as would have indicated inequality in the action of the polisher. So the working was continued with one-third stroke and a very slight side motion (testing at intervals) until the polish was nearly complete, when the final testing indicated a tendency of the speculum to assume a hyperbolic curve. Consequently the stroke was shortened to barely 1 inch, and the polishing was continued for fifteen minutes. At the end of that time the mirror indicated the effect illustrated in Fig. 62, an almost spheric curve with a tiny depression in the centre, and a depressed ring near to the edge.

These irregularities are the inevitable result of an extremely short stroke (without side motion) on a

* If the grinding has been carefully performed, the curve should be spherical.

faceted polisher; to remove them and give to the speculum the parabolic curve (shown under test by the faintest possible indication of hyperbolic shadow, Fig. 64), the stroke was lengthened to $1\frac{1}{2}$ inches, and the working again maintained for fifteen minutes.

The speculum then presented an appearance almost identical with that shown in Fig. 64. Had the polish been complete it would have been advisable to test the mirror in the telescope before proceeding farther, but it was deemed necessary to continue the polishing, and the stroke was shortened again to 1 inch for fifteen minutes.

As was anticipated, this shortening of stroke resulted in the re-appearance of the central depression (as in Fig. 62, but without the ring near to the edge), so that for the next period of fifteen minutes the $1\frac{1}{2}$ inch stroke was resumed with 1 inch side motion, so that the centres of speculum and tool should not be coincident at each stroke. At the conclusion the testing presented the appearance indicated in Fig. 63. The curve appeared to be almost perfect.

Subsequent test in a telescope proved it to be slightly over-corrected,* and it required a little judicious retouching with short strokes to perfect it. The final appearance is indicated in Fig. 64.

A few comments on these notes of actual working may be here made.

With regard to the time required for polishing. This will vary according to the degree of perfection to which the glass surface has been brought in the fine grinding. The writer has always made it the rule to carry the last grinding to the highest pitch of excellence possible, so that five minutes' polishing has had a perceptible effect upon surfaces he has prepared.

Any irregularity visible on the surface should call forth careful investigation, so that the stroke may be amended at once if necessary, and it will be of great after-service to the amateur if during the earlier stages of the polishing, he experiments a little as to the effect of the different strokes, working (for example) with a very short stroke for five minutes, and then gradually lengthening it to bring the curve back to its former condition—constantly testing. By such means only will he obtain that full control over the working, which is indispensable to rapid success.

The record of figuring just presented to the reader is the simplest record the writer has made; the final retouching of a mirror, often occupying many hours or days, in one case nearly a month.

The time is occupied, not in perfecting the polish,

* When the figure of a speculum is parabolic, it is said to be corrected for the reflection of parallel rays; if spheric, it is under-corrected; if hyperbolic, over-corrected.

but in obtaining the *exact* curve; and to do this it is often found necessary to silver the mirror, place it in the telescope, decide from the appearance of a star* in and out of focus, the quality of the glass—then to clean the silver off with acid; work, silver, and test the glass again, several times before the absolutely perfect stage is reached.

The following extract will point the moral of the extreme delicacy of manipulation required, better than a page of platitudes: "I had an eight inch speculum," wrote a correspondent of the author's, "in beautiful order, but thought it necessary to give it a few minutes' more polishing. So I cleaned off the silver, warmed the glass in water, worked carefully for two minutes, and then tested. I was astonished to find a fearfully overdone (*hyperbolic*) figure. So without thought, in a kind of nervous despair, I proceeded to bring the figure back (*by shortening the stroke*). When I had worked for a little time, and reason began to operate again, I saw that it was the effect of the heat that had made it appear so over-corrected. But, alas! in the meantime I had lost my beautiful figure. I do not like to think of the time it took me to recover it, fully two hundred hours, probably more. Deep scratches disappeared little by little, absolutely polished out."

So that it is very evident how necessary it is to avoid carelessly handling or heating the speculum during the final figuring; indeed, the stroke ought to be very slow indeed to avoid all chance of error.

My readers will remember that the longer the focus of the speculum is, with regard to its diameter, the nearer the curve approaches the sphere, and, consequently, the more delicate will the shading be. Conversely, the shorter the focus of the speculum in proportion to its diameter, the more marked will the shadows visible on the completed mirror be. In our case, the perfect mirror tested at the centre of curvature should present no decided figure at all, but should be a "study in greys"—a uniformly illuminated ground, having superimposed upon it the faintest possible indication of the hyperbolic shadows, Fig. 64.

Finally, one should not keep mechanically to an exact stroke, but should strive, while preserving the general class of stroke, to vary it in every possible way between small limits, so as to prevent the formation of rings of unequal polish.

In Fig. 62 there is shown a slight central depression, the result (granted that the polisher is properly constructed) of a continued short stroke. If the mirror be otherwise perfect, such a depression may be allowed to pass as of no consequence, the central inch or so of surface in a parabolic reflector,

* After rules to be hereafter noticed.

not being used; it is covered over by the shadow of the smaller mirror.

A speculum by one of the best artists, labelled by him "absolute perfection," and proved by use to merit the label, had such a depression. An attempt to remove it would probably have spoiled the exquisite figure.

We have now to consider other facts and resources, which may aid us in figuring. The first, is that of working by measurement; the testing at the centre of curvature being the means by which the measurements are made. Although a knowledge of the principle is very desirable, and, indeed, necessary to the amateur optician, it is not likely that mathematical measurement will ever supersede the necessity for experience, and experienced opticians do not depend upon mathematical measurement.

FIG. 62.—APPEARANCE OF SPECULUM UNDER TEST. CENTRAL SHADING INDICATES A TINY DEPRESSION. RING SHADOW NEAR EDGE INDICATES SLIGHT DEPRESSION THERE ALSO.

FIG. 63.—APPEARANCE OF SPECULUM UNDER TEST. SHADOWS INDICATE AN OVER-CORRECTED (HYPERBOLIC) FIGURE.

If a spherical mirror be tested at the centre of curvature, the rays will be found to be all of the same length. If the same mirror be carried out and placed in the telescope, the rays from the central part of the reflecting surface will be found to be longer than those from the edge, because the incident light is composed of parallel rays (see Chapter I.) The distance between the foci is called the longitudinal aberration. If, then, we measure the distance between the focus of the inner and the focus of the outer rays in the latter case (finding it to be, for example, one inch), and then returning to the workshop, work the speculum until when tested at the centre of curvature, the inner rays are found to be one inch shorter than the outer; the mirror placed in the telescope again would reflect all the rays of the same length and would be of a parabolic curve.

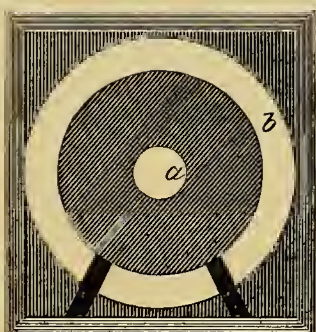


FIG. 65.—PASTEBOARD SCREEN FOR TESTING BY MEASUREMENT OF ABERRATION.

To state the same fact in other words. If a concave speculum, capable of defining celestial objects perfectly in the telescope, were taken out, and tested at the centre of curvature, it would be found that the rays from the edge would be longer than those from the centre; and if the difference of length * were carefully measured, and a mirror precisely similar in dimensions worked until its amount of aberration equalled that of the perfect mirror, the newly formed mirror would also be perfect. "But," asks the reader, "not possessing a perfect $6\frac{1}{2}$ inch speculum of 5 feet focal length, how is one to ascertain the amount of aberration?" Easily.—Given the diameter and focal length of any proposed mirror, it is possible without any extensive knowledge of mathematics to calculate the exact amount of aberration, which should be the peculiar property of a perfect mirror of similar dimensions.

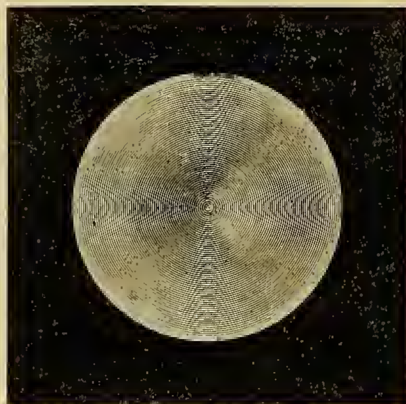


FIG. 64.—APPEARANCE OF PERFECT SPECULUM UNDER TEST. DIAMETER, $6\frac{1}{2}$ INCHES. FOCUS, 5 FEET.

The formula is, *the semi-diameter* of the speculum *squared*, divided by eight times the principal focal length. Where the diameter is $6\frac{1}{2}$ inches, and the focal length 5 feet (60 inches) the aberration should be

$$\frac{\left(\frac{6\frac{1}{2}}{2}\right)^2}{60 \times 8} = \cdot 022\ldots$$

or rather more than $\frac{1}{50}$ of an inch.

* The longitudinal aberration (see Chap. I.)

For measurements of this kind it is necessary to mount the block of the screen for cutting off the rays at the centre of curvature, upon a slide graduated to the one-hundredth of an inch. Then placing a card-board disc, as in Fig. 65, before the speculum, find first the exact focus of the central portion (A), and mark the position occupied by the screen, that is the focus of the centre rays. The screen should then be adjusted until the light vanishes equally from the exposed ring at the edge (B) that will indicate the focus of the outer rays. The distance between the two positions of the shutter will be the amount of aberration possessed by the speculum that is being tested, and in our case that distance should be just over one-fiftieth of an inch.

We will suppose that when tested, instead of the outer rays being just about one-fiftieth of an inch longer than the inner (as they should be), the inner rays are found to be longer than the outer by 2 inches or 3 inches (which is quite within the range of possibility, and, indeed, very desirable, as will be seen hereafter), then we should polish so as to deepen the centre of the speculum until the inner rays by measurement were found to be sufficiently shortened. Or if the outer rays were 2 inches or 3 inches longer than the inner, then we should know that the mirror was hopelessly over-corrected, and we should return to fine grinding; but the ordinary shadow testing should have shown us that before.

The delicacy and uncertainty of this system of measurement in the hands of a beginner, can scarcely be appreciated. The writer remembers a speculum being constructed on this plan by one who had but a very faint knowledge of the art of testing. Certainly the speculum was of a very long focus, and consequently the aberration was proportionately small, but at last it was concluded that the exact amount theoretically required was obtained. With triumph the result of the workman's labour was directed to a star—to his intense mortification he found the mirror required considerable retouching to perfect it. Every precaution was made to secure accuracy of measurement, yet it was only by taking the mean of several readings that the exact focus of the exposed parts of the speculum under test could be discerned (as the experimenter will soon discover). Not because of a difficulty in measuring, but because of the difficulty of determining within a fiftieth part of an inch the exact position at which the screen cuts off the light from the inner or outer parts uniformly. The inadvisability of the amateur relying entirely on such a process is evident. The proper method is to thoroughly master the principle of the shadow test, and the effects of different lengths of stroke, and then to use the measurement, if at all, as a convenient adjunct.

It was just written that to find the central rays to be two inches or so longer than the outer, would be very desirable. This, for the following reason:—It will be noticed that such an effect would be the property of an oblate spheroidal figure, the section of the apparent solid of which shows a central hill. Such is the best figure for the beginner to work from. All that has to be done, is to reduce that hill as much as is required, polishing the speculum most at the centre and least at the edge until the hill is lowered and the whole surface of the speculum is of the same focus (spherical); and then a few minutes' cautious work on a precisely similar plan will shorten the central rays to the required length and make the speculum parabolic.

And how would one work to deepen the centre? A very short stroke would do this, polishing most at the centre and least at the edge; but there is another method—namely, that of graduating the pitch facets from the centre to the edge. Leave the central facet untouched, but diminish the others gradually until those at the edge are only one-half of their original size. By this process, the deepening of the centre is very soon performed. There is every reason to believe it is the method adopted by one of our most eminent speculum makers.

The lines for diminishing the facets should be carefully marked on the pitch with a straight-edge and a lead pencil; and then, the cutting carefully done, not vertically, but at an angle, so as to leave each reduced facet of its original size at the base.

It has been suggested by some workers, that by the judicious carving of the polisher, into different shapes in this manner as circumstances demanded, any figure might be communicated to a speculum with ease. From a number of experiments, the writer has arrived at the conclusion that except in the case just stated, the best polisher to work with is one perfectly whole, as in Fig. 35; for any mutilation of the polisher introduces irregularities into the figure, which render it impossible to perfect the speculum without re-figuring it on a full-sized and perfect polisher.

Many who have read these papers may possibly lay them aside with the impression, not to say conviction, that the work of speculum grinding and polishing is one that is far too difficult for an amateur to accomplish, and that it will, therefore, be as well for him to let it alone altogether. I do not hold this opinion in any way: what man has done man can do, and what I have accomplished as an amateur, it is possible for others of my class to accomplish. Bear in mind that to him who will persevere nothing is insuperable.

(*To be continued.*)

THE WOODBURY TISSUE.

A SUBSTITUTE FOR GLASS IN PHOTOGRAPHY.

By JOSEPH HARRIS.

IF there be one thing more than another which has militated against the pleasurable pursuit of photography, especially in the field, it is the intolerable weight which has had to be carried while engaged in the usual occupation of photographing those ancient acquaintances, the village church, the castle ruins, the lovers' walk, the distant view of the abbey from the mud bank of the river, the old bridge which is coming down as soon as Local Government Bill is passed, etc., etc.; and as these subjects have the peculiarity of being situated about three country miles apart from each other, it becomes a serious matter to those whose bodily power is exceeded by the strength of their ardour in picture making, when called on to carry the necessary pounds weight of glass through the heat and burden of the day in order to secure the "regulation" number of negatives.

"Have you not made a slight mistake, doctor, in the position of the liver and the heart; is it not the liver which inclines to the right, while the heart is more to the left?"

"Eh? What? Mistake? Certainly not! It used to be as you say, once, but science advances, and we have changed all that now!"

And "the Doctor, in spite of Himself" in one point of his reply had reason on his side. Science certainly does advance, and the photographer, be he professional or be he amateur, may henceforth wend his way in search of the beautiful with a light heart, which for ought he care may incline right or left, his *impedimenta* in the shape of support on which to take his negatives is to be computed no longer in pounds but in ounces; the requisite material to serve for weeks of picture-taking can be carried in the coat pocket without encumbrance. Glass has been relegated to the past, and paper has taken its place.

It is a matter of common notoriety that for years past experiments have been pursued with a view to rendering paper serve as the support on which the sensitive gelatine film shall be impressionable by light. Glass is weighty, cumbersome, and fragile, and somehow most fragile when a valuable negative rests upon it; to depose glass and to substitute paper, which is light, which is portable, and which will not break, is therefore a step in the right direction. The objections to paper have been twofold: firstly, the "grain" which has given a coarseness to the finished positive print; and, secondly, the *degree* of transparency which has been imparted to the prepared paper, rendering the negative more like a picture taken on *ground* glass than a negative taken upon an absolutely *translucent* support. And this ground glass effect with its consequent slowness of printing quality was only attainable after great mess, after great annoyance, after much uncertainty, and after serious humiliation. Castor oil is not the most agreeable of substances to manipulate; it brings to mind memories of the past, which are not happy ones, and when served up with a hot iron induces the reflection that it is not every photographer who has served an apprenticeship to his laundress, and supposing for a moment that success is to ensue from the operation, can it not be reached without wielding the domestic flat iron?

But the hot flat iron plus castor oil or vaseline only gives us a semi-transparency, and if ironed too much or too little, too hot or too cold, not enough of the semi-transparency. The late Mr. Woodbury fully realized this defect, and his efforts, which have been crowned with success, were directed in the endeavour to make paper *absolutely translucent as glass*, and to place this translucent material in the hands of the photographer without giving him further trouble. Mr. Woodbury argued, and rightly, that from the photographer nothing should be expected but the artistic use of the materials placed in his hands, and that if the operator could make pictures on a certain percentage of his exposures, allowance being made for failures, it was taxing his exertions unfairly to expect that man to go through a new, an unnecessary, and a disagreeable process, to make each one of those pictures sufficiently transparent to be printed from. Various experimentalists were at work, paper was universally recognized as the support for the sensitive gelatine film; but why should a photographer have more work with his paper negative than with the old glass plate before he can pass the picture into the hands of the printer?

It was a long period of anxious working and suspense, of repeated trials, now in one direction and now in another, seven weary years of hope deferred while the goal was often sighted before the Napoleonic maxim—"Everything comes to him who knows how to wait," was verified in the matter of absolutely translucent paper. Success was achieved amidst a general consensus of opinion that the labours of the past would be amply rewarded by the brilliancy of the future, when once more there was darkness, darkness most profound, and the grave closed over the inventor!

It has been the business of the Woodbury Tissue Company to bring this great discovery of Mr. Woodbury's into a practical and a working condition. Extensive premises have been constructed under the

supervision of one of the most eminent engineers in the country, no expense has been spared, no suggestion left unnoticed, to produce the most perfect tissue in the market, and this tissue it is now the company's pride and pleasure to submit to the photographic world.

The manipulation of the tissue is simplicity itself. A slight modification of Beach's developer gives the best results. The developing solution should be poured into a tray and the tissue carefully immersed therein ; the formation of air balls especially on the under surface of the picture being guarded against by use of a camel-hair brush. No alum bath is required, and the hypo fixing bath is used in the same manner as with paper positives. After washing for a few minutes from the hypo, the negative should be placed for a quarter of an hour in a ten per cent. solution of glycerine and water to render it flexible, and then finally washed for a minute and suspended to dry.

It may not be out of place to note here the tenacity with which some of us while awaiting the discoveries of the present cling to the traditions of the past. Scarcely is it necessary to observe that one great advantage of paper over glass is the lightness and portability of the former. And yet "shadow catchers" are to be found who take their negatives on this paper by "using a piece of glass in the dark slide, and putting the tissue on it." On the score of surplus weight to be carried, there is not any advantage in this arrangement. Equally it is certain that the paper without some "backing" will not work in the ordinary dark slide. Equally again it happens that there never is a difficulty but some inventive genius is sure to attempt the bridging of that difficulty ; and the photographer's dark slide reconstructed for paper work is no exception to the very ordinary rule. We have slides with stretchers and elaborate complications which require a second apprenticeship to master their intricacies ; but the practical man requires a slide which will almost fill itself, the paper must fall into its place without those beautiful arrangements affected by too many would-be "inventors"—*Mirabile dictu!* The "roller slide" was nearly overlooked ! That marvel of human ingenuity which enables the photographer to sally forth armed for twenty-five exposures at one outing, deserves mention. Suppose only two shots are desired at the express train in full motion, why tramp about with such a cumbrous piece of machinery as this roller slide. Suppose an enthusiast has been at work, and twenty shots are the result of the day's "exertions," and suppose this enthusiast when he reaches the sanctity of his dark room desires to develope firstly, No. 10, which is the "portrait of a lady," then No. 3, which represents, or ought to represent, a certain trysting place anent which there are very tender associations, and then No. 17, which was taken under the usual "disadvantages." Now what with the rolling and unrolling of that tissue, it is quite possible for it to become involved in a most serious muddle long before the twentieth "shot" makes its appearance, while the remaining five papers which have not been exposed cannot be rewound, and may therefore be thrown away. This is scarely an invention which can be correctly designated as progressive.

In Vergara's patent dark slide, which has been constructed especially for the Woodbury Tissue, every want of the practical man has been met. First of all it is extremely cheap, about one-third the price of the usual double slide, and equally well made with the best of them though not brass bound and not made of "Spanish" mahogany ; secondly, it is portable, being about one-half the thickness of the regulation slide, and can be adapted in a few minutes to any camera ; thirdly, it is light, about one-third the weight of the old slide ; fourthly, it might be filled by a blind man without possibility of failure. Draw out the central division and place it between one of the double "papers" from the box, return the whole to the slide which is now filled for *two* exposures. There are no buttons nor catches to turn, no hingeing up of parts in a dim light, with the uncertainty sometimes which way the hinge works. Vergara's slide is perfectly light-tight. The man who takes life easily can indulge to the top of his bent, and dispense with the use of the "rag" when carrying his slides to and fro in the open air, while he who is cautious will dispose of three of them, or six exposures, in one coat pocket without the weighty reflection that, however transparent glass may be, there is no doubt about its being a metal.

In a succeeding article a description of the manufacture of the tissue and of the works at South Norwood will be given.

(*To be continued.*)

A CHEAP OVERHEAD MOTION.

By J. L DWYER.

MR. THOMSON'S article in Vol. IV., page 420, of AMATEUR WORK induces me to relate my experience in a like position. Like him, I wanted an overhead motion, and did not wish to spend money; but, unlike him, my outlay did not amount to twenty-five pence. After maturing my plans, I went to the ironmonger, got a piece of inch T iron 6 feet long, and another 2 feet 6 inches long, total cost one shilling. The longer piece I bent, cold, into the form

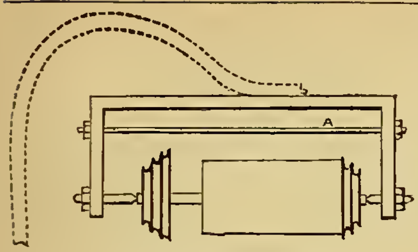
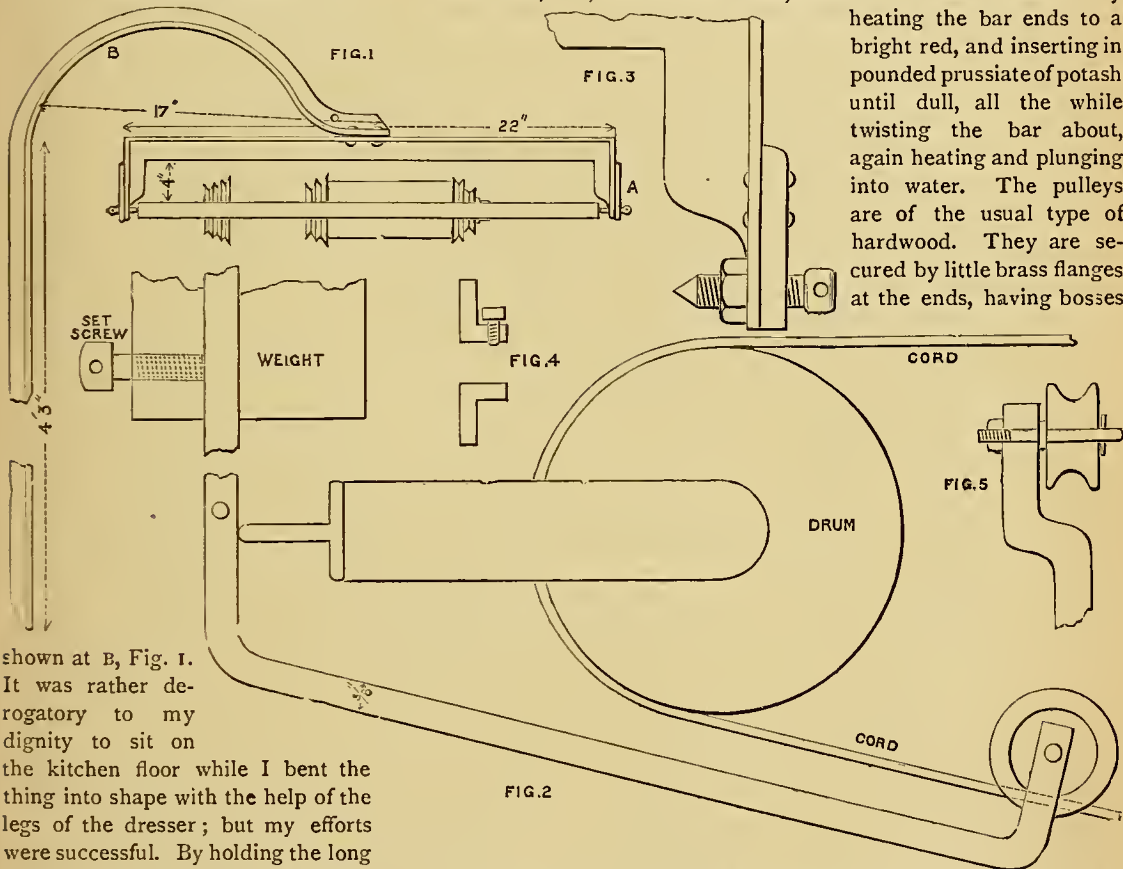


FIG. 6.—MODIFICATION OF FIG. 1.

piece and screwed into the upper one. When I had finished this part of the work I found on examination that the ends of this lower piece when the backbone had been removed were decidedly too thin to take the centres, so I put strengthening pieces at the back, as shown, Fig. 3, riveting them on. Three-eighths inch steel screws with conical points, and having lock nuts in front, engaged the spindle, which is ⅝ inch iron turned and polished the whole length. The bearings at the ends, *i.e.*, the centre holes, should be case hardened by heating the bar ends to a bright red, and inserting in pounded prussiate of potash until dull, all the while twisting the bar about, again heating and plunging into water. The pulleys are of the usual type of hardwood. They are secured by little brass flanges at the ends, having bosses



shown at B, Fig. 1. It was rather derogatory to my dignity to sit on the kitchen floor while I bent the thing into shape with the help of the legs of the dresser; but my efforts were successful. By holding the long end I could bend it fairly easily, and I found only that part in contact with the near leg of the dresser to bend, leaving the rest straight, so that by moving the bar backwards and forwards I got just the curve I wanted. The dimensions of the various parts are given in the figures, as the reader will find on referring to them. The shorter piece was a little more troublesome. The ends were heated in the fire and bent at right angles, as shown, between the bars of the grate; the puckers formed in the backbone being beaten out with a hammer and flat iron. Domestic as were my utensils, I managed this job far beyond my expectations, which may be a matter of some surprise to those who are not so much accustomed to makeshifts as I am. The two pieces were next fastened together with four ¼ inch screws passing freely through the lower

FIG. 1.—OVERHEAD MOTION, COMPLETE. FIG. 2.—TIGHTENING BAR AND PULLEY. FIG. 3.—ENLARGED VIEW OF A, FIG. 1. FIG. 4.—FLANGE FOR PULLEYS. FIG. 5.—END VIEW OF PULLEY.

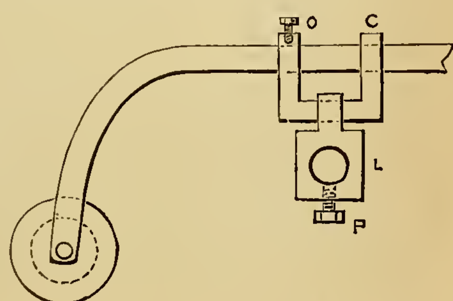


FIG. 7.—APPARATUS SLIDING ON BAR A, FIG. 6.

through which pass pinching screws, Fig. 4. I think the figures will explain all other details. The whole is secured to the wooden lathe frame by five screws passing through the web of the T iron. It is so rigid that a friend of mine when first shown it said I could hang myself on it. It springs, however, a little, but I consider that an advantage; in fact, Holtzapffel, from whose lathes in the Inventions I got the idea, uses a spring between the support and the pulleys. The only disadvantage is that the lateral spring is considerable. This, however, I remedy by putting a $\frac{1}{4}$ inch stay between the top and the wall near, one end of which is secured to the upright with bolts, and the other to a flange screwed to a board nailed against the wall. If T iron a little stronger, say $1\frac{1}{4}$ inch, were used, I think it would not require this support.

It may be asked how I intend to use those cutters having a traverse motion, and where the band cannot travel along the drum, thus requiring a varying band, cutters for wheel-cutting, for instance.

I have not used such yet, but the plan represented in Fig. 2 has been used with success in first-class ornamental lathes, and will no doubt be successful in mine. Different degrees of tension could be got by moving the weight backwards or forwards. The tightening bar should be hinged in some way to the top of the cross bar. I have not yet decided how, but if anybody desires to complete that part I will be happy to give the matter my attention and forward a drawing to "Amateurs in Council." The tightening pulley, as represented, should be wide with the edges well rounded off to prevent its cutting the band.

Since writing the above I have adopted the plan shown at Fig. 6, A is a $\frac{3}{8}$ inch bar, secured with nuts at the end. On it slides an apparatus, shown at Fig. 7, which is really an universal joint; L is a piece of $\frac{5}{8}$ inch square iron, with a $\frac{3}{8}$ inch hole drilled at one end, and the other end turned $\frac{1}{4}$ inch round for a distance of $\frac{3}{8}$ inch. On this fits a piece of flat iron, C, $\frac{5}{8}$ inch by $\frac{1}{4}$ inch, bent into the form U, and holes are drilled in the legs to take the bar of the tightening rod. By this arrangement the tightening pulley can travel along with the cutter, keeping the cord tight. I ought to mention that there are little pinching screws at O, P, but the latter is scarcely ever used.

Perhaps I had better say that the diagrams are not drawn to scale, but are merely intended to be explanatory sketches, exhibiting the method that I adopted. The scale on which this appendage to the lathe is to be made, and the relative proportions of the various parts, must be suited to the size of the lathe for which it is to be constructed. Bearing this in mind, I think that my diagrams will prove sufficient for all practical purposes.

CUTTING AND POLISHING ROCKS AND ROCK SECTIONS.

By O. BECKERLEGGE.

IN looking through the volumes of AMATEUR WORK one can easily imagine that not only does it supply material for pleasant recreation, but much instruction that can be made available for profit. I am sanguine enough to hope that the following article may be utilized in such a way. At present there are but few who undertake the cutting and preparing rock sections. It is deemed almost beyond the amateur's powers. I think this may be accounted for, in the first place, by the fact that machines for the purpose are expensive. Simply, I presume, because there is but a small demand for them, and not because they are complicated; and, secondly, there is but little literature on the subject—very little, indeed—beyond answers to correspondents in sundry magazines, which give information on the construction or use of such machines. I cannot imagine any other causes, as I know that the art is not difficult to learn—delicacy of touch and judgment being required more than any great dexterity or power of manipulation. It is one of those arts which may be *easily* picked up or *not* at all. If the delicacy of touch is not there, then no seven years' apprenticeship will enable one to be a section cutter. One of the best section-cutters in London—and that means the world—picked it up almost by an accident; his slides, now, however, are found in the cabinets of the leading petrologists, both professional and amateur, in the United Kingdom. If, then, I can be the means of helping but one reader of AMATEUR WORK to become a skilled section-cutter, this article will not be written in vain. I have said that a machine is expensive, costing several pounds. Let us then, as good amateurs, make our own.

I might say here, that to begin with a cutting disc is not essential, as good sections can be made from chips knocked off with a chisel and hammer. Still, if we are going to do the proper thing, we may as well arrange for a cutting disc. Out of 2-inch square pine make two oblong frames, 3 feet long by 1 foot 6 inches wide, join these together at the corners by four strong pillars 6 inches long. One frame will ultimately be covered with boarding, so as to form a table. In framing the bottom two bars must be mortised, as shown in Fig. 1, A A, 9 inches from each end; these will take the feet of the spindles.

We will now proceed with the driving-wheel. In a recent number of AMATEUR WORK directions were given for constructing a good driving-wheel of metal; if, however, there are any difficulties in the

way of constructing such an one, we will proceed to make one of wood, which will be heavy enough for our purpose, as the work to be done is not like that of a lathe. Procure two lengths of pine 15 inches long by 3 inches square; dress them up square and true, halving out each piece in the centre, having previously gauged them to half the thickness, so that when put together they will lie perfectly true one with the other. Make a good fit. When they will bed down perfectly true, glue and screw them together; this will be the foundation of the wheel. Find the centre of the wheel on each side, seeing by measurement that your marks are exactly opposite each other. Out of 1-inch board make four segments to fill in the wheel, draw your gauge down each limb one inch from the edge in the angles to be filled up, so that the segments may be fastened in true. When a good fit is secured glue them in their place and fasten with sprigs. The centre will stand out each side about an inch above the segments, inasmuch as the centre is of 3-inch wood and the segments of 1 inch wood. With a compass strike a circle; if one is not to hand, stick a bradawl in the central mark, and with a cord, strike a circle; do this each side, and cut down to the mark and finish off with a rasp. Out of each side of the four ends of the centre cut a piece—say 4 inches, down to the segments. We now must cut four segments of a circle of half inch greater radius than the wheel, for each side, Fig. 2; these must be screwed to the wheel, having first had the circumference made as true as possible. When in their place, they will form a groove for the belt to run in. There will be now left four V-shaped panels in each side; these can be filled in. The joints of the segments will be broken in the middle of the arms; if carefully made, this wheel will be very strong, and equal to everything we may require. Such a wheel as this might be weighted with plugs of lead in the circumference, and used for many other purposes than the one before us. Bore a hole 1 inch diameter through the centre, for the spindle; bore from each side. We must now procure a spindle. A smith will easily make one out of 1-inch square iron; it must be 12 inches long. One end must either be filed, or, better, turned to a point, and should be case-hardened; this will rest in a bearing. About six and a half inches from this point a bearing must be filed or turned to work in a collar screwed to the table, Fig. 3.

In the centre of the bar, which is nine inches from the end of the bottom frame, screw a bearing for the foot of the spindle to work in. On the top frame fasten a board, which will form part of a table; let the edge come level with the centre of the bearing in the bottom frame. Where the spindle comes, cut out half a circle. Now make two plates of sheet brass, $\frac{3}{8}$ inch thick and 2 inches by 4 inches long, on one edge of each, cut a half circle, or nearly so, screw one half to the fixed top, in the meanwhile seeing that the spindle carrying the driving-wheel is perpendicular and not inclined to wobble. Fasten a second piece of board to the top frame, bringing it close to the first, and screw the second plate of brass to it. These two will now form a collar in which the spindle will work; a crank handle attached to the top square of the spindle will be the means of driving it.

We must now procure another spindle 18 inches long; one end must be turned to a point to rest on a bearing the same as the first one. On this drive a piece of mahogany or other hard wood, 4 inches in diameter and 2 inches thick; this must be placed so that when the spindle is in its place its centre must be level with the centre of the driving-wheel. On the other end of the spindle, drive another piece of similar dimensions, this must be about six inches from the first. When they are driven tightly to their places, the spindle must be placed in a lathe and the first be turned into a sheave, the second piece is to be turned perfectly true on its upper side, and will form a bed on which either the slitting disc or the lap will rest; the part of the spindle above this bed must be turned round to receive a screw-thread for about—say 3 inches, and the remainder turned $\frac{1}{8}$ of an inch smaller. Fig. 4 will make this clear. At M, Fig. 5, a bar of iron must be firmly fixed to stand perpendicular with the table. This may be fixed firmly by having a screw-thread cut at the lower end and a nut and washer screwed on to the rod a sufficient distance to allow the rod to pass through th table, and then another nut and washer screwed on it on the under side of the table, gripping the table between the nuts. This, or any other device, may be adopted to give firmness to the rod. We now want a link with a hole at each end, as B, Fig. 5; be careful that the centre of the holes are the same distance as the centre of the spindle and steadying rod. A thumb-screw, as at K, Fig. 5, will fix the link firmly in its place. We will suppose our lap to be made—how to make it will appear as we go on; so we will proceed to put our machine together as far as we can. Our driving-wheel is easily fixed.

Now lay the lap on its seat, and screw down the nut so as to grip it firmly, placing, of course, a washer between the lap and nut; place the spindle in its step B, Fig. 1, put the link on the spindle and steadying-rod, and with the thumb-screw fix it in its place. A belt passing round the driving wheel and sheave will complete the machine so far. Having done so much we have got over the most difficult portion of our work, and have secured a machine which will

answer all the purposes of one costing several pounds.

Our next business will be to make jaws to hold the stone to be cut; but it must be distinctly understood that the machine, as at present constructed, is equal to the performance of slide making, as the rock can he chipped; but supposing we wish to have a complete machine we will proceed to the slitting arrangement. At L, Fig. 5, a rod must be fastened to the table in the same manner as the steadying-rod just described. On this must be fitted either a metal or wooden collar, which can be fixed at any height by a thumbscrew. The most satisfactory arrangement for fixing the jaws will be to make a piece of metal as N, Fig. 5, to which the jaws can be screwed. It is the most economical arrangement in the long run to have this iron limb, because the wooden jaws naturally wear out by gripping rough stones, and a fresh pair can be easily applied. But, supposing the trouble or expense is an objection, then simply to lengthen one half of the jaws—long enough to reach the standard, and bore a hole in the end to receive the standard—will be sufficient for occasional work.

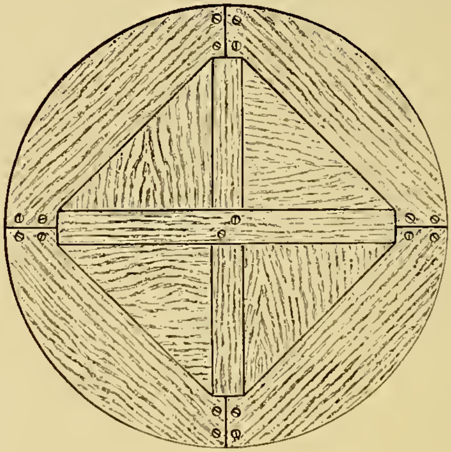


FIG. 2.—DRIVING WHEEL.

To make the jaws, procure two pieces of hard wood 1½ inches square, one, say, 16 inches long, the other 12 inches. Through the short length bore holes as indicated, large enough to take a thumbscrew, such as are used sometimes for securing table tops. In the long length two corresponding holes must be made, but small enough to hold the thread, or small nuts may be screwed on. Between these the rock can be firmly held. The height is regulated by the collar on the standard, the jaw limb simply resting on it. From the extreme end of the jaw there extends a cord, which passes over a small pulley in front of the table. A small weight at the end of the cord keeps the jaw with sufficient force to the slitter. For particulars of slitting disc, etc., I must refer my readers to an excellent article on "Cutting and Polishing Pebbles," in Vol. IV., page 505, of AMATEUR WORK. I may just say here that for many of the rocks diamond dust is not necessary, as emery has quite cutting power sufficient.

FIG. 3.—SPINDLE FOR DRIVING WHEEL. A, Turned Depression for Brass Bearing.

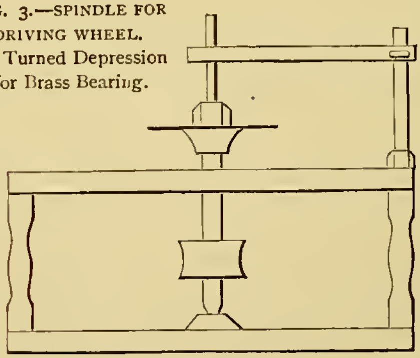


FIG. 6.—END ELEVATION OF FRAME.

Having now fixed the rock in the jaw, and adjusted it to the right height for cutting, let us steadily turn the fly-wheel, and according to the hardness of the rock so will be the speed of the cut.

Having cut off the rough outside,* we must raise the jaw by unscrewing the collar on the standard, and raising it, say, one-eighth of an inch, but the thickness will depend on the nature of the rock on which we are working.

So far we have supposed that we have but one spindle; as a matter of fact, we must have a duplicate of the one carrying the cutting disc for the purpose of carrying the lap. At first it might appear easy to take off the slitter and put the lap on; well, so it would be, but the probability is that the slitter would not be put on in exactly the same position, and would require trueing up, which, in the long run, what with time and trouble, would be far more than having a separate spindle. For the purpose of unshipping the spindle the table is made in four parts, Fig. 5. To remove one spindle and fix the other is only the work of a minute or two at most.

Now, although we cannot make a slitting disc of soft iron, I think we are quite equal to a lap. Make a hoop of thin iron, say 8 inches in diameter, and 1½ wide, tin-plate will answer very well, the ends must not be soldered but riveted, this can easily be done with small tacks. Place the hoop on a level iron or wooden plate, be sure it is fairly level, else your lap will be thick on one side; run a little plaster of Paris or clay around the outside of your mould to prevent the molten metal from running out. Exactly in the centre of the hoop fix a wooden core a shade less

* This rough piece can be utilized, if desired, by simply polishing the cut side and fixing it to the glass, and grinding the rough side on the lap.

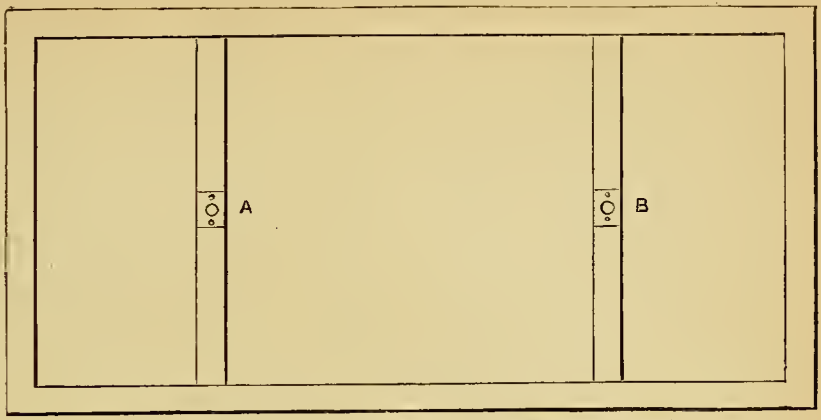


FIG. 1.—LOWER FRAME. A, B, Bars with Bearings for Spindle.

than the spindle, now run in your molten lead carefully; when cold, mount it on the spindle as before directed. Mix sixty-hole emery, and water, not too thin, and place a little on the lap. Now turn the wheel, and hold a piece of flat stone on the lap, the result will be that the emery will bed itself in the soft lead, which will ultimately become so charged that it will cut anything in the form of hard rock—steel, will not touch it; indeed, nothing but the diamond and a few other precious stones will prove superior to its bite. We will suppose our machine is now completed for all practical purposes.

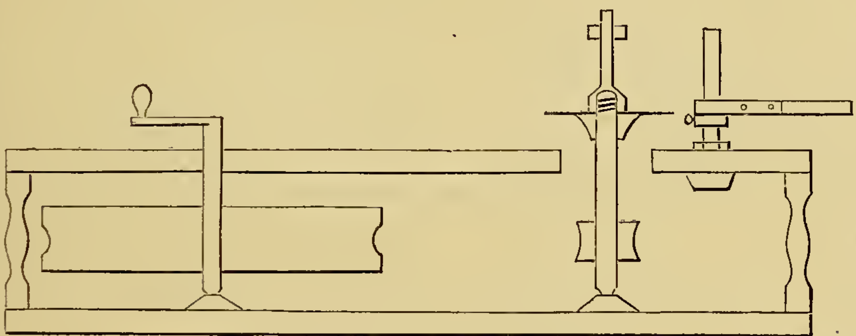


FIG. 4.—VERTICAL SECTION—FRONT VIEW.

Let us now take another step. For mounting rock sections we shall want the following materials and appliances:—One or two ozs. of Canada balsam in a wide-mouthed bottle—a disused and clean pomade bottle is the very thing; an ounce or two of commercial benzole, be sure you do not make a mistake and get benzoline; a broad and shallow glass dish, you can make it by cutting off the top of a tumbler or other drinking glass; a confectioner's straight-sided small show glass, just large enough to go over the tumbler glass last referred to; a dozen pieces of plate glass about 1¼ inch square; a small spirit lamp — not benzoline lamp; and a small oven 6 inches wide by 6 inches high and 3½ inches deep from front to back. Two inches from the bottom, make three holes in each side, and 2 inches above these make another row of holes. Now put three stout iron or brass wires from side to side in each of the two sets of holes, and we shall have, practically, two shelves in our miniature oven, on which we can place what we wish to bake, for this is really the purpose to which it will be applied. Light your lamp with a very small flame, practice will show how much fire you need. Set your oven over it, on a tripod or by

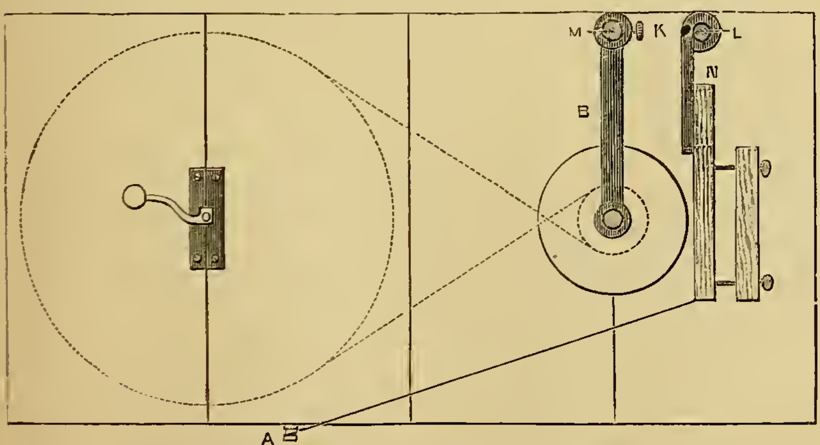


FIG. 5.—TOP OF TABLE. A, Pulley carrying Cord from Jaw.

any other means; place on the front lid or door, and you can get and keep your oven to any temperature you choose, and, here again, "practice makes perfect;" and, last of all, we must supply ourselves with glass slides and covers—the former are pieces of thin glass 3 inches by 1—until some proficiency in mounting is attained, perhaps such as an amateur could make himself would answer his purpose—get a sheet of thin clear glass as free from specks and striæ as possible, and cut it in pieces 3 by 1 inches; carefully look over what you have cut, and reject all such as have the least flaw near the centre. On the lap you can grind off the sharp edges, so that they shall look more sightly and also be safe in handling. The thin covers with the slides can be procured of any optician, round covers are about 3s. 6d. an ounce; square ones about 2s. 6d.; but the round ones will make the neatest looking work, an ounce will contain a very great number.

I have enumerated all the material we need for our work, except it be a piece of thick flat iron, say 5 or 6 inches in diameter. The face of this must be perfectly true, or, what is better, have it turned in a lathe slightly convex, but there must only be just a suspicion of convexity. The reason why it is best to have it slightly round in the centre is, that in rubbing there is always a danger of getting the edge of the section thinner than the centre; by having the plate for rubbing on, slightly convex this danger is lessened.

Having got all our materials and appliances to hand, let us proceed to work, and our first work must be to prepare a mounting fluid. Take a wide mouth phial and put a little, say ½ oz., of hard Canada balsam, in it, also about an equal quantity of benzole; let it stand securely corked in a warm room until the balsam is perfectly dissolved; an occasional shake will help it on. The right consistency will be learned by practice. It must be thin enough to drop from the point of a stick just like golden syrup. If too thin add more balsam: if not thin enough, then add more benzolė. Of course, this must be kept well corked as it is very volatile and inflammable. Now we shall proceed on the assumption that we have not gone to the expense of a slitting disc, and are working with a chisel and hammer. Take the portion of rock of which we are about to make a section, and having selected the most even side, hold it firmly on the lap, keeping the lap at the same time well moistened with emery and water. When we have obtained a good flat surface it will still be rough; and we must, therefore, place a little flour emery with water on our iron plate, and with a circular motion rub the ground surface on it until all the scratches are out and it presents a uniform dead appearance. A pocket lens will be of signal service. When all the scratches are well out, rub it on a water of Ayr stone. A few rubs will give the desired polish. This side is so far finished.

Now take a little of the hard balsam and place it on the centre of one of the thick squares of plate glass, place it on a sheet of iron supported by a tripod over a spirit lamp until it melts, then put on the rock, which must be warmed by placing it on the hot plate, with the polished side next the glass; be very sure that the rock is dead on the glass. Get as many specimens as you can on to this stage, and then put them away for the day that they may set and harden, as until the cement is hard you cannot proceed. We will suppose that this desirable object is secured, and that we may now safely proceed.

Here now commences the work of skill and delicacy. The rough side must now be ground down. Great care must be taken that the section is ground level. At first there will be a danger of making one side of the section thicker than the other; this must not be so. Watch your work carefully. You will get by experience to *feel* when you have got it to the requisite thinness. When as thin as stout writing-paper, most rocks will begin to transmit the light. Watch it through your eye-glass, as a single turn on the lap may destroy all your work. When you are satisfied that you have gone far enough on the lap you must transfer your section to iron plate and treat this side as the other. The cutting power on this will be, of course, much slower, and consequently it will be much safer. Examine it with the lens to see that *all* scratches are out, and that it is of equal thickness all over, and that it is transparent. Now give it a final polish on the water of Ayr stone. It must now be removed from the glass bed on which it has been ground. To do this place the sections in the shallow glass dish referred to, and pour enough benzole in it to cover the sections. Now invert the glass jar over the dish; this will keep out all dust and prevent evaporation. A few hours will dissolve the cement, when the sections will easily slide off with gentle pressure.

We will call this the end of the second stage, and shall proceed to the final one, viz., mounting. Prepare as many slides as you need by carefully wiping, removing all dust and specks. Take the mounting medium, and with a bit of clean wood drop a little on the centre of the glass slide. Now gently, and with care, transfer with a sliding motion the specimen from the glass bed to the slide. Adjust it with a needle set in a bit of wood for a handle, and see that it is fairly in the centre of the slide. To do this you can draw a parallelogram 3 inches by 1 inch on a card, and place a central mark on it; by placing the slide on this

you will be able to centre your subject accurately. When centred take your glass cover, let it be perfectly clean, which may be done by holding it in an old silk handkerchief between the finger and thumb, giving a sweeping motion. This will clean the glass without breaking it. Of course, it must be done with care as it is very thin. Having cleaned the cover, place a drop or two of the medium on the section. Now take up the cover by the edges between your finger and thumb, and place it on the section inclined at an angle. If put on flat it will almost be sure to include air bubbles; but if it be put on with a falling motion there will be far less danger. Either place a small weight on the cover, or else put it in a spring clip, so that the superfluous cement may be squeezed out. Let it remain an hour or two to harden. When you have prepared enough to fill your oven, place them on the bars and light your spirit lamp. See that the oven is hot enough to *bake*, but not hot enough to *boil* your slides; a little practice will enable you to judge the height of flame you require. If you boil the balsam you will make it full of bubbles; besides, if you do not break your glass, you will discolour the cement. I may just say here that supposing you do not care to go to the trouble of making an oven, you can do the work equally well in the kitchen oven when it is warm, and leaving the slides in it all night. Of course, there is always the danger of their being forgotten or of being broken. But I have known the kitchen oven used with excellent results. When the heat has driven off the benzole and turpentine the balsam will be quite hard; the slide must now be cleaned. The greater portion of cement can be removed by gentle scraping, and then finally cleaned with a rag moistened with *methylated spirit*, as benzole might find its way under the slide. When finished so far, label it, giving the name of the rock, if known by you, and the date when made. It will be a matter of interest to you in time to come.

It is now time for us to have a better view of our work, and for this purpose we must employ our microscope. If you have never seen a rock section before you will be surprised and delighted, for many of the sections, depending of course on the nature of the rock, will appear to be made up of beautiful crystals. It will be like a new revelation to you that a bit of stone from the hedge side contains so many beautiful forms. But we have only half seen our sections; to enjoy them fully we must attach our polariscope, which I have before described, Vol. IV., page 184. Many rock sections will show splendid colours without a selenite plate; others require the selenite plate to bring out the colours. Now we have, indeed, a vision of beauty, for the crystals are all aglow with the richest colours and tints, every crystal of a different nature, having its own colour. I have made no calculation as to the cost of such a machine as I have described, as I take for granted that the amateur can make the whole of the machine with the exception of the iron work and slitting disc, and beyond which there is little else than wood and labour. Having commenced preparing objects for our microscope, we purpose describing in a future paper how other objects than rock sections are mounted.

Note.—It will be understood that the machine is constructed so that it may be clamped to a table. A deep tin shield like a dish with central hole for the pulley to pass through will prevent the water from being thrown around.

Should any amateur purpose constructing the machine, but first would like to know probable cost of the ironwork, and how to get it done cheaply, I shall be glad to give him information. A letter through the Editor will find me.

NOTES ON NOVELTIES.

By THE EDITOR.

48. SKINNER'S "ECLIPSE" SERIES OF FRETWORK DESIGNS. 49. ZILLES' STEEL RINGS FOR FRETWORK. 50. ZILLES' ARTIFICIAL PLATES OF IVORY, ETC. 51. ZILLES' WOOD VICE FOR AMATEURS. 52. "SOME HINTS ON BEDDING." 53. MESSRS. THOS. J. SYER AND CO.'S NEW CATALOGUE. 54. FACEY'S "PRACTICAL HOUSE DECORATION." 55. BROWN'S "PRACTICAL MANUAL OF WOOD ENGRAVING."

48. SKINNER'S "ECLIPSE" SERIES OF FRETWORK DESIGNS.—Messrs. J. H. Skinner and Co., *East Dereham, Norfolk*, send me a selection from their "Eclipse" Series of Fretwork Designs, which exhibit marked improvement both in the nature and character of many of the subjects and in the style in which they are printed. In printing fretwork designs, it is a great mistake, in my opinion, to use black ink on a white ground, the contrast between black and white being too violent and startling, and differing far too much from the actual appearance of the article in wood when finished, and the background, be it what it may, against which it is placed when relegated to the position it is to occupy, to make the eye to catch at once and appreciate its points and excellence at their true value. Messrs. Skinner and Co. have recognized this fact by producing their present issue of designs in various shades of brown, which approximate far more closely to the average tint of wood than black does, and lend to them a softness which is at once pleasant and attractive to the eye. My readers are well aware that I am not partial to the introduction of animals and figures into fretwork designs, but in Wall

Bracket, No. 160, I find a very clever and tasteful treatment of field-mice, corn, and cornflowers which would not fail to look well when reproduced in wood. No. 158 is an elaborate corner bracket, with ovals for mirrors or photographs, but the designer utterly disregards the fitness of things by placing the animals and birds that are introduced in positions that they do not relatively occupy in nature. Thus, at the top of the design is a rabbit, next a squirrel, next an owl, and at the bottom a bird preparing for flight. A little consideration would have suggested the total reversal of this order—the rabbit, which does not climb, being at the bottom; the squirrel, which can and does climb, next in order; the owl next, and the lighter bird above. No. 184, a folding ornament, comprising six cabinet photos and mirror, is at once novel, ingenious, and in every way well designed, the floral ornamentation being the wild convolvulus of the fields, conventionally treated. No. 159, giving the sides of a hanging lamp for a hall, will look effective when cut, but I should prefer myself to line the fretwork panels with white ground glass or coloured glass instead of silk or satin. No. 180 is a bold and good design for an ornamental writing-desk, with paper and pen racks, but it is rather calculated to serve as a repository for writing materials than for actual use. No. 181 is a quaintly formed hanging toilet tidy, which, I think, would be satisfactory and look well when made up.

49. *Zilles' Steel Rings for Fretwork.*—Mr. Zilles has also added to his stock some steel rings or clasps, which are useful for holding together pieces of fretwork when gluing them together. The work is fitted and glued, and the rings are then placed over the pieces in contact, in order to bring them closely together, and retain them in this position until the glue is set. They are made in four sizes, namely, 1½ in., 2½ ins., 4 ins. and 6 ins. in diameter. The price being 6d., 7d., 8d., and 1s. respectively. The extra amount for postage is 1d. for the two smaller sizes, 1½d. for the third size, and 2½d. for the fourth size. Mr. Zilles also sends many sheets of new and beautiful designs for ornamental woodwork, but of these I need not speak in detail of them, as my opinion of Mr. Zilles' designs is already well known to all my readers. His reduced price list, No. 26, of Cabinet Fittings, Mouldings, Tools, and Fancy Woods, all of which amateurs will find most useful, especially the fittings and mouldings, is now on sale, price 2d., and should be in the possession of all fret workers, carvers, etc.

50. *Zilles' "Artificial Plates of Ivory,"* etc.—Mr. Henry Zilles, 14, *South Street, Finsbury*, has submitted to me some very beautiful specimen plates of artificial ivory, tortoiseshell, mother-of-pearl, iris shell, and marble in different colours, which have been specially prepared for the benefit of more advanced fret-workers, and which those who are skilled in the use of the fret saw will find most useful. These substances may be used for sundry purposes—namely, for ordinary fretwork, and for inlaying and overlaying, and can be cut with Zilles' "New Patent Champion Fret-saws," which I have already noticed, nearly as easily as wood. The plates are not so apt to break or bend when being cut, as real ivory, tortoiseshell, etc., but it is better and safer to place them between two thin layers of wood when cutting out very delicate work, as this will preserve the polished surface and insure perfect safety from breakage. Beside, this, by adopting this course the necessity for removing the design from the material itself is obviated, and the substances may be glued to one of the two layers of wood for strength. These materials will be found useful for cutting out brooches, pins for which Mr. Zilles keeps in stock at 2d. per pair, earrings, and other articles of jewellery, as per sheet, No. 712, and also for covers of note-books, borders, solitaires, etc., examples of which will be found among the designs given in the sheets numbered 541, 566, 608, 625, 627, 628, 630, 631, 632, 633, 659, and 681, and for many other ornaments in combination with fretwork. No one need be deterred from using these novel and beautiful materials by reason of the fine lines in the designs, for as long as there is sufficient strength in the material the saw can be manipulated so as to cut hair-lines as well as coarser ones, and delicate work will always be more appreciated than rough work. The sizes and prices of the plates are as follows:—

Ivory	about	6¾ inches × 4½ inches,	2s. 0d.
Tortoiseshell	„	6½ inches × 4¾ inches,	2s. 0d.
Iris-shell	„	5 inches × 5 inches,	2s. 6d.
Mother-of-pearl . . .	„	5 inches × 4¾ inches,	2s. 6d.
Marble in different colours . . .	„	7¾ inches × 5 inches,	2s. 3d.

For postage 2d. per plate extra must be added to the above prices.

51. *Zilles' Wood Vice for Amateurs.*—Mr. Zilles also sends a specimen of a useful wooden vice which amateurs who have not the room to accommodate a large wood bench, or who cannot go to the expense of one, will find a handy and useful substitute for it. This vice can be screwed by means of a wood screw to any table, and is made of well-seasoned tough wood. It may be utilised in bevelling the side-pieces of baskets, boxes, etc., which are required to be fitted at an angle; for boring, sawing, filing, planing, sand-papering, and staining fretwork, and for adjusting glued work, which may be left in it to dry. There are, indeed, many other uses to which it may be put which it is needless to enumerate, but which will render it worth far more to those who furnish themselves with one than it costs. Being of wood, it may be used for holding delicate wood without fear of fracture, which it might sustain if put into an iron vice. The instrument consists of two jaws, one fixed and the other movable, with a steel spring between them to offer resistance to the screw in drawing them together, which is effected by an ordinary wooden screw which is similar to, and acts in the same manner as the wooden screw in a carpenter's bench. The ledges and screw by which the vice may be attached to a table are fastened to the back of the rigid jaw. The jaws are 4 inches broad and 11 inches high, and will easily grip and hold work 2 inches thick. The price of the vice is 7s. 6d., postage 9d. extra.

52. *"Some Hints on Bedding."*—Those who are interested in sanitation and the preservation of health at home, will find much excellent advice in a tiny pamphlet entitled "Some Hints on Bedding," being part of a lecture delivered by the author of "Bed Feathers," "Bedding Material," etc., who is one of the firm of Messrs. Urquhart and

Adamson, Cabinet Makers, Upholsterers, and Purified Bedding Manufacturers, 13 *and* 15, *Bold Street, Liverpool.* By those who carefully read this Magazine, the name of Adamson will not be passed without pleasing recognition. I regret I have not space to quote largely from the pamphlet, but it may be sufficient to say that it urges the frequent cleansing and renovating of all bedding whatever may be the material of which it is made, and it gives some useful notes on the various materials used in the manufacture of bedding. Although the advice it contains is priceless, yet the pamphlet itself is without price, and will be sent free to anyone who may care to apply for it and read it.

53. *Messrs. Thos. J. Syer and Co.'s New Catalogue.*—Messrs. Thos. J. Syer and Co., 1, *Finsbury Street, Chiswell Street, London, E.C.*, have advanced beyond fly sheets, and have issued a handy and serviceable catalogue of their specialities and the various articles in which they deal, which now includes tools of every description used in carpentry and joinery. Messrs. Syer and Co., it is well to note, are patentees and sole makers of the "Champion" Scrub Washing Machines, and the Universal Mitre Cramp, Joiners' Bench Knife, etc., of which the two last named have been already noticed in these pages. The cost of the Catalogue itself is 3d. Messrs. Syer and Co. are turning their attention to the supply of technical workshop fittings for schools, and show in page 5 an excellent design for "The Multiple," a bench at which six students can be working at once, and which has been supplied by them to the Central Institution of the City and Guilds of London, Dover College, Dulwich College, Bath College, and other educational establishments throughout the kingdom. Their new registered Tool Cabinet, "The Kensington," and improved lock-up chisel racks, both of which are illustrated in page 7, deserve the attention of all amateurs. In the cabinet there is a place for everything an amateur can require, and everything can be kept comfortably in its place. Amateurs will gather many useful hints by looking through this catalogue.

54. *Facey's "Practical House Decoration."*—Messrs. Crosby Lockwood and Co., 7, *Stationers' Hall Court, Ludgate Hill, E.C.*, have recently produced, at 2s. 6d., as a new volume, (No. 257) of Weale's Rudimentary Scientific and Educational Series, "Practical House Decoration, a Guide to the Art of Ornamental Painting, the Arrangement of Colours in Apartments, and the Principles of Decorative Designs, with Some Remarks upon the Nature and Properties of Pigments," by James William Facey, author of "Elementary Decoration." This work, the author explains in the preface to the volume, is, in a certain sense, a sequel to the book just mentioned, and is intended to help all painters and decorators, whether masters or journeymen, gives an insight into the laws which govern the application of colours to various purposes of house furnishing and ornamentation, and to induce them to work, not as mere machines that have only to actuate the brush by which the colour is laid on, but with a genuine love for and heartfelt appreciation of the art and trade which it is given to them to exercise. All this the work in question is eminently well calculated to bring about, and it will prove as useful to the amateur in this direction as to the professional workman. After explaining the relation of ornament to the colour theory in the opening chapter, the author proceeds to treat of the properties of colours, the laws of harmonic contrast, the application of colour to apartments, and the admixture of colours for surfaces, thus ably and pleasantly combining theory and practice. The arrangement of wall surfaces and combination of colours for interiors is next brought under notice, and this is followed by notes on the characteristics of mural decoration and the composition of decorative work, in emblematic forms suitable for the purpose to which the various apartments are to be devoted. Considerable, but by no means too much space is devoted to working, shading, and ornament in polychrome—a term used in the ornamental arts to signify a combination of such a variety of colour as, indeed, is indispensable to carry out particular effects. We are then led on to a consideration of various styles and periods of ornament arranged in alphabetical order, commencing with the Assyrian and ending with the Roman. A few chapters on the theory and practice of painting and house decoration in oil colours, and a good index form the concluding portion of a book of 196 pages including titling, preface, etc., which is pleasant and instructive to read, and contains many illustrations which, in many points, cannot fail to be useful and suggestive both to the student and the practical workman.

55. *Brown's "Practical Manual of Wood Engraving."*—Messrs. Crosby Lockwood and Co. are also the publishers of "A Practical Manual of Wood Engraving, with a Brief Account of the History of the Art," by William Norman Brown. The author allows in his preface that his "little book does not pretend to be a full and comprehensive work dealing with the art in every and any possible degree, but rather a thoroughly practical and easy introduction to the study, giving representative lessons." This description of the book under consideration is undoubtedly true as far as the first part of the statement is concerned, but is scarcely in strict keeping with the subject matter of the book itself in the second portion. It certainly tells the student in a practical and easy way *what* ought to be done, but does not go so far as it might and ought in showing *how* to do it. The examples given are good in themselves, and nicely drawn and engraved, but they are not sufficient for the guidance of the self-taught student, who would in ninety-nine cases out of a hundred fail to reach the excellence of several of the examples given in attempting to make copies of them, and would thus get disheartened. The book, in fact, is not sufficiently elementary and progressive, and gives one the idea of being rather the production of a compiler than a skilled engraver who has the power of imparting instruction to others. As far, however, as printing, execution of illustrations, and binding go, this pretty little book of 80 pages in all is all that can be desired. My notice is based on the reply to a question that I put to myself after looking carefully through the book. The question was, "Could I *learn* to engrave on wood, with this book only as my guide, philosopher, and friend?" The reluctant answer after making all due allowance for the assistance it would afford was—"No!"

AMATEURS IN COUNCIL.

**** For Instructions to Correspondents, see page 44 of this Volume.*

Frame Work for Panorama.

Artist.—The machinery used in working a Panorama costs many pounds, and it would take some few articles and many drawings to explain it in these pages, so it is quite outside the scope of this part of the Magazine. Consult a stage carpenter, and get him to make you a model. An advertisement in *The Stage* newspaper for such would bring many answers.—H. L. B.

Spellier's Electric Clock.

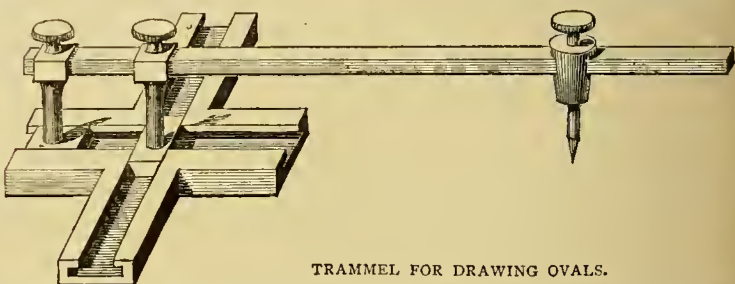
Lex.—The following furnish replies to your queries with reference to Spellier's Electric Clock. I do not give your questions *in extenso*, as they are sufficiently indicated by my replies: (1) The figures accompanying a description of this clock, given in page 133, Vol. III., were taken from the "Electrical Review," and reproduced for Amateur Work. The scale was not given in the original. I suggest that the parts are shown three-quarters size of a small model. (2) As Mr. Spellier directs an insulating substance to be used in separating the two springs at the bottom of the pendulum, this should evidently be made of metal, presumably brass. The only "bob" used is the weight x on the lever U, and this controls the speed. (3) I would suggest a small model of, say, one-fourth larger size than that shown in illustration, Figs. 4 and 5. (4) In Fig. 4 *b* appears to be a set screw fastening a thin spring to top part of pendulum, by which the pendulum is suspended. M is evidently the spindle, which carries a geared wheel O, and this is worked by a worm wheel behind the escapement (not shown in sketch). I only suppose this. (5) The bar under D E supports the pivot of this lever and the arm I. (6 and 7) I take it that Figs. 1 and 2 give exact sizes of bobbins, escape wheel, and cogs, together with angles of the same. In such a small model, with ⅛ inch soft iron cores, No. 28 silk-covered wire, six layers on each bobbin. No. 20 for leading wires and line wires. (8 and 9) The pivot of U is at P. Two projecting pins working in holes, form the pivots or axle. To ensure perfect contact, a platinum pin is inserted in the outer projecting pivot at P, and against the tip of this pin is made to press a spring, secured to the support of the pivots at T. With this help I hope you will be better able to understand the figures than myself.—G. E.

Electric Clock.

E. W. (*Holloway, N.*) writes:—"I am pleased to inform you that I have succeeded in making an electric clock from your instructions in Part 49 of Amateur Work, and it is now going and keeping remarkably good time. I used an electro magnet of the size given, and covered it with No. 26 silk covered copper wire, using nearly ½ lb., the remainder coming in for the lengths required at back of clock, and from clock to battery. I had an old French timepiece of which I utilized the dial, hands, front plate, etc., and purchased small brass binding screws for holding the springs to racket, wheels, etc. These answer very well as the spring can be easily adjusted. The battery is composed of three one-quart Cabaret cells, which I find quite sufficient for the motive power. The cells are placed in a box on a ledge on first floor landing, and wires lead from them to the clock, which is on a stand under a glass shade, on a mahogany bracket in the hall, where besides its usefulness, it is quite an ornament. A number of friends, etc., have seen the clock, and they are both surprised at its simplicity, and pleased with its appearance and novelty. I shall be pleased to show it to any person who may desire to see it." [Name and address of correspondent will be sent to anyone enclosing stamped and addressed envelope to the Editor with "Electric Clock," written in lower left-hand corner.—Ed.]

How to Draw Ovals any Length or Breadth.

Dublin Amateur writes:—"Having read with considerable interest the correspondence in your previous issues relating to methods by which ovals are described, I herewith send a description and diagram of an appliance, which I think is the most perfect. I obtained it from Messrs. Booth Bros., *Dublin*. It affords me complete satisfaction, enabling me to draw an oval of any shape. Unlike many mechanical arrangements for amateurs, no time is lost in adjusting, except measuring off the major and minor axis of the required oval, the oval can then be produced with expedition and accuracy. The following is a description of the instrument, and comprises, as shown in the diagram, a wood or metal block crossed by two slots cut in the direction of the cross. A short arm (about 15 inches long), has upon it three trammel heads, two of which are attached to two T headed pieces, which fit into the aforesaid slots or grooves; the other head is to receive the pencil. The extreme points equal the radius of the major, and the middle point and pencil the minor axis of the oval to be described. The instrument is placed upon the surface on which the oval has to be drawn, the arm is then rotated, the two T heads sliding in the base assumed, their respective positions in the slots, and by their movement the oval is accurately drawn. Amateurs will find that this will overcome all difficulties arising out of the more crude methods of the string and pins, or working it out with the compass, which is very tedious, and above all things inaccurate, as much difficulty exists to make clear and suitable connections between the circles thus drawn.



TRAMMEL FOR DRAWING OVALS.

Portrait and Landscape Lenses.

W.—If W. had carefully read the paper on lenses he would have seen that a portrait lens is altogether unsuitable for landscape photography, owing to the form of the lenses, they being ground so as to secure the greatest rapidity possible, so that when taking a portrait, only a short exposure is necessary. In the first place there is hardly any depth of focus (page 294), that is, if we focus for a certain object with a portrait lens, everything else before and behind that object will be out of focus; if, however, we use a landscape lens in its place, objects are brought into sharp focus which are at some distance before and behind the principal object. Next, there is a great amount of spherical aberration or roundness of field, which is described in the same page, and illustrated in Fig. 26. Lastly, the marginal definition is bad, and these, combined with several minor defects, render the portrait lens unsuitable for any other purpose than portraiture, where these faults are hardly perceptible; indeed, the little depth of focus is in portraiture an advantage. W. cannot do better than obtain a rapid rectilinear or symmetrical. They are very rapid, and exactly suited for instantaneous photography; in fact, nearly all prize pictures of yachts, express trains, etc., are taken with these lenses.—C. C. V.

Screwdrivers.

Goldsmith writes:—"I suppose all have heard of the question proposed to the Royal Society at the commencement of its career, 'Why does a dead fish weigh more than a live one?' Long discussions followed, until one member thought it would be as well to try if the thing were a fact; and, upon trial, it was found to be a hoax. Now I feel tempted to put the same question with regard to the screwdrivers, and I don't believe that an extra long tool will act better than one on which there is room to apply the power conveniently, and this I consider to be the whole solution of the question. I can conceive that a broad blade will have more power than one narrower than the length of the notch, and also generally a long screwdriver has a handle of larger diameter than a short one. Carriage builders use one with a handle formed like a crutch to give power. S. is mistaken, I think, when he says the fulcrum is the centre of the notch and the weight the two ends. I make the fulcrum

the sides or ends of the notch, and the resistance of the wood is the weight, and the *length* of the screwdriver has nothing whatever to do with the lever principle, for the power has to be applied horizontally in the same way as the wards of a key actuate the tumblers of the lock."

Small Dynamo Electric Machine.

E. W. E. (*Hackney*).—Two papers on the manufacture of a Small Dynamo Electric Machine will be found in Vol. III., pages 314 and 355 of this Magazine, or otherwise, in Parts 30 and 31.

Two-Way Tap.

WAIWERA (*New Zealand*) writes:—"I have an idea of a two-way tap suitable for hot and cold water from one pipe. It is my own idea, as I have seen nothing like it, and have been told that it may be turned to good account. If I sent description and drawings, could you do anything with them? and, in the event of the thing being any good, would you please give your advice. Supposing any of the many articles which appear in your magazine as designs, were taken up and manufactured by others, have you any protection?" [I have received the above through a correspondent to whom you had sent it. In future, kindly send any communications direct to me. If you send description and drawings, and, if possible, a model, I will see if the invention is a useful one and if anything can be done with it. Any one may make the articles described in this Magazine, excepting always those which are patented and noticed in "Notes on Novelties." If you wish to reserve the right of making and selling any article you may devise, you must take out a provisional or preliminary patent for it, which will cost you £3.—ED.]

Practical Scene-Painting for Amateurs.

R. B. (*Bedale*).—A thoroughly practical amateur, and a valued correspondent of this Magazine writes:—"I forward two Press opinions of our stage performances. But for AMATEUR WORK, I could not have done what I have. A stage platform, 31 feet wide, 20 feet from front to back, and 17 feet 6 inches high, having dressing rooms on either side, is no joke to make and fit up; but I most freely acknowledge my indebtedness to 'our' Magazine. I feel sure the whole arrangement will be used again and again. Our proscenium was taken from AMATEUR WORK, being the one with the two pillars, and the whole of the arrangements were carried out from suggestions given therein. The editor of the *Darlington and Stockton Times*, who likes these things, came over yesterday, asking to have a look at the arrangements, etc. He was much pleased with them, and I found when I told him where I got my hints, that he is a regular subscriber to AMATEUR WORK—'A Magazine,' he said, 'which every one who wishes to help themselves should read.'" [I am pleased to hear of your success in stage-building, and that "ours" has been helpful to you. Your task must have been by no means a light or easy one, judging from the critique in the *Darlington and Stockton Times*, which I have read with much interest, and from which I find, that in mounting the comic drama, "A Scrap of Paper," you had to prepare and paint three scenes: namely, A Drawing Room, the apartment of Prosper Couramont in the Chateau of Brisemouche, and a Conservatory attached to the chateau. I can fully appreciate your gratification with the notice of the performance given in the *Darlington and Stockton Times*, which, on looking through its columns, appears to me to be the model of what a country paper ought to be, giving all the news of the day, general and local, in an eminently readable manner and a fair, courteous, and pleasant spirit. I am glad to find that the editor is a reader of AMATEUR WORK, and I trust he will pardon the liberty I take in giving my opinion of an organ, one of whose chief functions it is to criticise the sayings and doings and productions of others.—ED.]

Dry Plate Photography.—Erratum.

Mr. C. C. VEVERS writes:—"In page 416, col. 1, line 25, for 'No. 3,' read 'No. 2.' No. 2 being the ammonia solution which should be added, and not the bromide solution."

Violoncello Making.

W. G.—A paper on making a violoncello is now in my hands awaiting publication. In this, I think you will find all the information you require. It will appear as soon as ever I can find room for it. I am glad to learn that you have been successful in making two good violins from Mr. E. Heron-Allen's instructions.

Glass Tube for Barometer.

B. F. (*Coldstream*).—I am informed by Messrs. H. and E. J. Dale, 26, *Ludgate Hill, London, E.C.*, that they can supply you with a glass tube for a barometer 2 feet 9 inches long to the bend, for from 3s. to 3s. 6d. Any application from you to them on this and kindred matters will receive prompt attention.

INFORMATION SUPPLIED.

Emery Wheel.

STADT DRESDEN writes in reply to F. A. E. (*Bailieboro'*):—"Do not think to save money by making emery wheels. I can only say that unless you want, or have use for scores, you had better buy them. Emery wheels are made by mixing emery with shellac, pouring it into moulds, and pressing in a hydraulic press. The Naxos Union Company supply wheels, files, etc., cheap enough for any one. Wheels cost from about 2s. 6d. to 15s. per dozen; files, 3s. to 12s. per dozen. Corundum wheels, 3s. to 36s. per dozen; files, 8s. to 16s. per doz. In the best wheels shellac is not used, but I do not know what is used instead."

Brazilian Pebble Spectacle Lenses.

Mr. W. W. DUNSCOMBE (10, *St. Augustine's Parade, Bristol*) writes in comment on my remarks on CRYSTAL's query in page 384, and also in reply to it:—"Although the advice you give CRYSTAL about working spectacle lenses is the best he can have, it may interest him and others to know that the numbers 4 to 60 are inches focus, and that the index of refraction of plate glass is such that spherical double convex lenses made from it have a focus equal to the radius of the curve of the tool with which they are ground. This will give the key to the focus of lenses of other forms. Brazilian pebble having a greater index of refraction than glass, the lenses made from it have a shorter focus than lenses of glass worked on the same tool." [Mr. DUNSCOMBE, I may be permitted to say, is optician to the Bristol Eye Hospital, etc., and, as an Optician and Scientific Instrument Maker who is well known in the West of England, writes with authority. His combined pamphlet and price list, entitled "Vision and Spectacles," which accompanies his letter is instructive and interesting, and has the merit of compressing many facts about eye-sight and spectacles into the smallest possible compass.—ED.]

Yarn Winder.

SIGNALMAN writes in reply to MAD JACK:—"Annexed is a rough sketch of a yarn winder of which I have made several. We will take the bush first. It is 2 inches diameter and 1 inch thick in centre, having recesses made in circumference ¼ inch deep to receive spars, and small groove round edge outside for wire to bind in the spars. When I say that it works much the same as an umbrella, you will see that it takes two bushes. With regard to the stand, I suppose MAD JACK will be able to make it without instruction. A piece of ¼ inch brass tube does very well for spindle, and a small wood saucer may be placed on top for holding ball in the event of having to put it down. And now for the spars, of which there are thirty-two; they are 9½ inches by ½ inch by ⅛ inch, and you will see by sketch how they are put together. Good hard wood, such as sycamore tree or beech, should be used for them. The rivets consist of ¼ inch scutcheon tacks, with a small washer of brass and copper wire to bind spars to bushes."

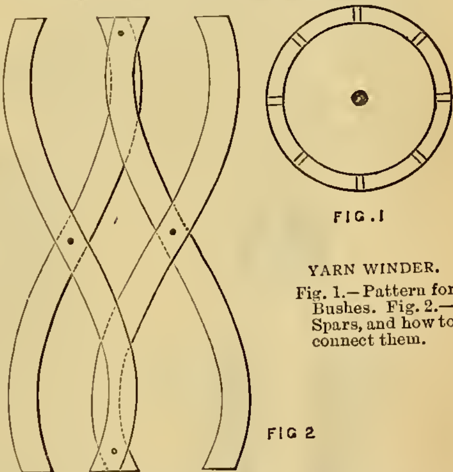


FIG. 1

FIG. 2

YARN WINDER.

Fig. 1.—Pattern for Bushes. Fig. 2.—Spars, and how to connect them.

Treadle Drilling Machine.

STADT DRESDEN writes in reply to N. E. SIGNALMAN:—"The form in sketch is abont the simplest you can adopt. Unless the wheels are of unequal size, I fear you will not be able to bore one in holes, nnmber of teeth, say 20 and 50. The vertical spindle slides through the bush B, Fig. 2, the cog-

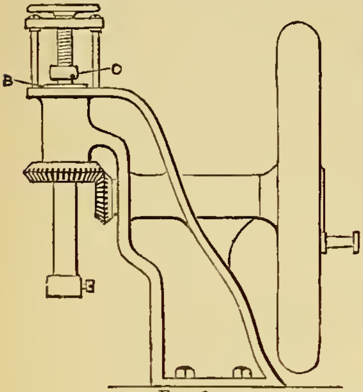


FIG. 1.

wheel is screwed or keyed to the bush; the spindle has a groove down it, abont three-sixteenths inch wide and deep; the two pins E are screwed through the bnsh, and fit in the groove, by these means the spindle will move vertically and revolve at the same time. The cap C is pinned to the spindle, and the collar D to the screw. The flywheel should be about 24 inches in diameter and 35 lbs. in weight. A rising and falling table is better than having a long

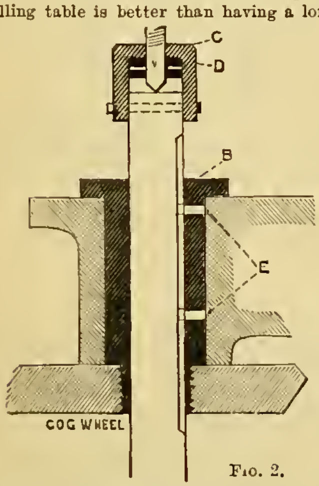


FIG. 2.

TREADLE DRILLING MACHINE.

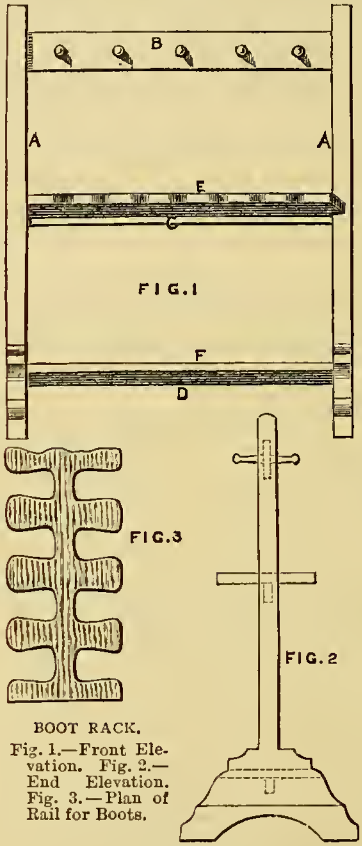
spindle. The spindle should not move vertically more than 4 inches. The sketches are not to any scale."

Metronome.

D. A. writes in reply to FARINA, page 384:—"I remember seeing somewhere that a clock pendulum could be regulated to serve for this. Perhaps the hint may be useful to FARINA if no one sends full reply to his enquiry. I am sorry I cannot give full details, as the source whence I got the idea has been forgotten."

Boot Rack.

D. A. replying to BAGS, sends sketch for boot rack, which can be made easily. The ends A A are much like those of a rather heavy towel-horse. Into them are mortised the top rail B (½ inch by 3 inches), middle C and bottom D. C and D need not be so deep as A, which has a row of wooden pegs projecting on each side, while they only serve to bind the two uprights, and to support the shelves E and F. E is shaped as shown on Fig. 3 out of ¾ inch stuff. The sketches show a double boot rack. A single boot rack has pegs and shaped shelf on one side only. The bottom shelf F may be omitted.



BOOT RACK.

Fig. 1.—Front Elevation. Fig. 2.—End Elevation. Fig. 3.—Plan of Rail for Boots.

Zincography.

H. E. GRANTHAM writes in reference to the appeal of W. C. (*Dumfries*)—"In page 336 of the current issue I see you ask if I could give instructions in the above method of printing. I am sorry to say I have no practical acquaintance with it, and from what I can learn from the chapter in 'The Grammar of Lithography' (price 5s., Messrs. Wyman and Sons, *London*), I should not consider it at all suitable for amateur work. The above book says on the general principles of zincography, 'As neither ink, crayon, nor gum penetrates the zinc in the same manner as they do stone, the printing is more liable to accident, and requires *great attention and skill* on the part of the printer.' The words underlined *I* have underlined to emphasize them, because if I lost nearly two years of my 'prentice' time when learning lithographic printing at press from not being shown *how* to do something, and as a consequence, was not able to keep the work in a decently long job in good condition, it is evident that even still smaller blunders than the one I first fell into will prove more disastrous to the resulting work. Besides, as the press, roller, ink, etc., used are just the same as for lithography, and the chief advantage of zincography is in large work such as no amateur would be likely to attempt, I think W. C. (*Dumfries*) may just as well go in for lithography instead. It is easier and the initial expense will be very little if any more than for zincography. The only book containing reliable information on the subject I have come across is the one I have quoted from. It is published by Wyman and Sons, *Great Queen Street, Lincoln's Inn Fields*."

INFORMATION SOUGHT.

Electro Thermostat.

ROVER wishes to know if an amateur could make an electro thermostat? He thinks it could be done by melting bits of platinnm wire into the tube of an ordinary thermometer.

Hammock Making.

W. A. (*Liverpool*) asks:—"Will any reader kindly give me some information on Hammock Making?"

Arrow Making.

W. A. asks:—"In glueing feathers on arrows, is any instrument used for keeping them straight and firmly pressed on through their whole length? If not, how is it done? If any such instrument, where is it procurable?"

Steel for Small Drills and Taps.

STADT DRESDEN asks:—"What is the best kind of steel for making small drills and taps, and where can I obtain it? The steel I am using is made, I think, by Stubs, and is sold in lengths of 13 inches. In use, it often twists off between the blue and the yellow of the temper without any apparent cause. The lengths do not all appear alike, as in cutting them up some are hard to break, while others break with less resistance than a biscuit; again, the fraction in some is grey, while in others it is nearly black. The last steel I have used has been out of old umbrellas, but the size is limited."

Cutter Bars.

STADT DRESDEN asks:—"Are there any cutter bars that will take the place of tools made as in the annexed illustration, and used for cutting or facing ends of rollers and round bars?"

CUTTER BAR.

LETTERS RECEIVED UP TO JULY 7.

[*Replies to these in Next Part.*]

F. T. (*Stanmore*); W. B. (*Oxford Street, W.*); STADT DRESDEN; G. R. R. (*Antwerp*); W. B. (*Whitehouse*); H. S.; J. C. (*Burton Fleming*); A. E. P. (*Hull*); T. S. (*Wolverhampton*); W. G. B.; A WANDERER; W. L. (*Golborne*); FLASHING DYNAMO; T. S. (*Wolverhampton*); B. S. (*South Hampstead*); L. S. D. (*Jamaica.*)

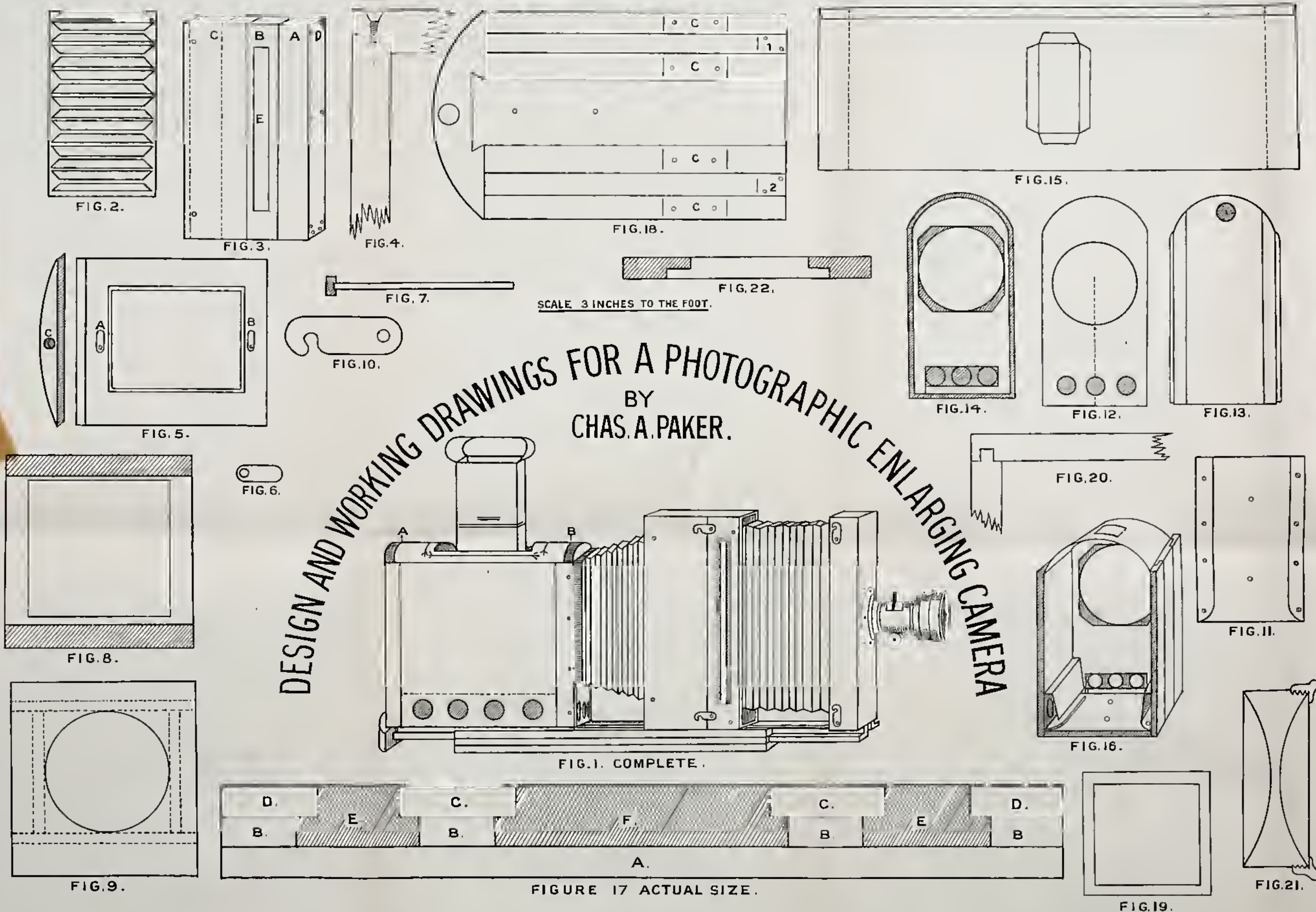


Fig. 1.—Photographic Enlarging Camera, complete.
„ 2.—Mode of Placing Cardboard Strips on the Bellows.
„ 3.—Body of Camera, marked for division.
„ 4.—Method of Joining Woodwork of Camera.

Fig. 5.—Carrier for Negatives.
„ 6.—Brass Clips for Carrier.
„ 7.—Section of Carrier.
„ 8.—Frame along which Carrier slides.
Fig. 20.—Another method of joining woodwork.

Fig. 9.—Frame for holding the Condensers.
„ 10.—Brass Clips for Clamping Camera.
„ 11.—Bottom Board of Lantern, showing Brass Strips.
„ 12.—End of Lantern.
Fig. 21.—Section of Condensers, in Brass Mount.

Fig. 13.—Sliding Door of Lantern.
„ 14. Method of Cutting Tin Lining for end of Lantern.
„ 15.—Tin Body for Lantern.
„ 16.—End View of Lantern-Body when complete.
Fig. 22.—Section of Side of Lantern-Body.

Fig. 17.—Section of Baseboard actual size)
„ 18.—Plan of Baseboard, with position of Apparatus marked.
„ 19.—Frame for Small End of Kinnear Bellows.

THE "BURSOOLAH," OR EASTERN ADZE.

By C. E. D. BRANSON, Lieut.-Col. 17th Bengal Infantry.

THERE appeared in the beginning of last year in "Amateurs in Council," page 96, "A useful hint to amateurs—Coachmaker's Axe," by a Practical Coachbuilder. After reading this it struck me that the Eastern "Bursoolah," or adze, would be found a more useful tool, and I intended sending you a description of it, and of the way in which it is used, in order that should you think it of sufficient interest, you might at some time or other find room for the description and sketches in "Amateurs in Council." Before I could carry out my intentions I was sent on active service in the Soudan, and remained there till November last. Since my return to India I have been so busy that I have not been able to do anything in the way of writing the description.

I am sending you a full-sized "Bursoolah," which I hope you will accept. The Indian one is made of iron tipped with steel, and is somewhat clumsy in appearance, but I can assure brother amateurs that after a little patient practice, they would find this a very useful tool. It can be used for all sorts of work, rough and fine. Held as shown in Fig. 4, it is used for cutting timber to a marking line, so as to leave but little work for the plane, and very often dispenses with the use of the jack plane. It would often be very tedious work squaring rough timber without such a tool, and as an old amateur myself, I can assure others that they would find this adze easier to use and handier than an axe. Wood can be very quickly prepared for the lathe with this tool. Stakes could be more easily prepared with this adze than with the axe. It makes a very good mallet and hammer. The wood to be operated on is first marked as usual, and then placed in the notch in the log shown in Fig. 1 at right angles to that log. Care must be taken to humour the grain of the wood, as when using any other cutting tool. It is a mistake attempting to work too fast, by hacking off big chunks at each blow. As practice makes perfect, it is wonderful with what confidence one can wield this seemingly

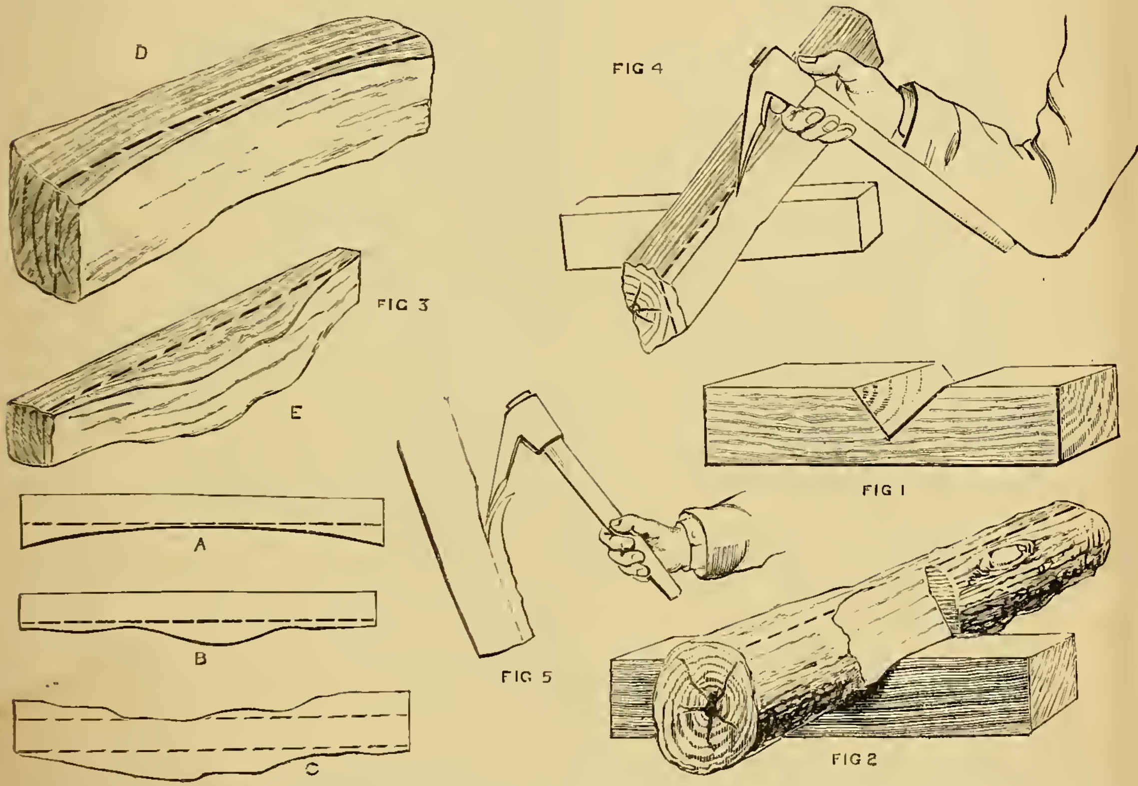


FIG. 1.—NOTCHED WOOD BLOCK USED WITH ADZE. FIG. 2.—ROUND LOG MARKED FOR SQUARING, AND SQUARING COMMENCED. FIG. 3.—EXAMPLES OF ROUGH WOOD THAT CAN BE REDUCED TO PLANKS OR SQUARED BY ADZE. FIG. 4.—ORDINARY WAY OF HOLDING ADZE. FIG. 5.—MODE OF HOLDING ADZE FOR ROUGH WORK.

clumsy tool, and with what accuracy work can be produced with it.

Some further details than those which have been already given will be desirable, and these will go far to explain the construction of the adze itself, the uses to which it is put, and the manner in which it is used. In Fig. 1, as it has been said, is shown the log which is used to support any piece of timber that is being surface dressed, or brought to a plane surface by

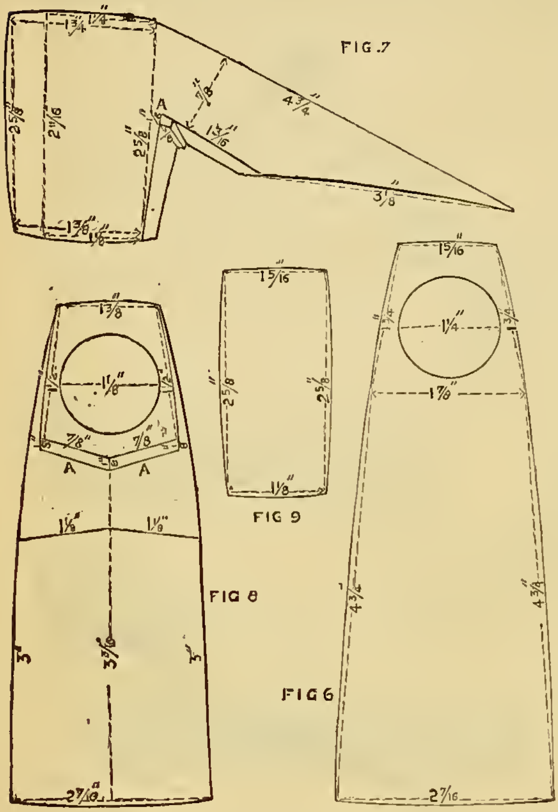


FIG. 6.—VIEW OF TOP OF ADZE, SEEN FROM ABOVE. FIG. 7.—SIDE ELEVATION. FIG. 8.—VIEW OF BOTTOM OF ADZE SEEN FROM BELOW. FIG. 9.—ELEVATION OF BACK.

means of the adze. The notch is a V-shaped notch, made across the log in its centre, and is so cut that its sides form a right angle at the line of intersection, and an angle of 135° with the upper surface of the log. In Fig. 2 is shown a round log marked for squaring, and placed in the notched log for support, while the work is being carried on. In Fig. 3 five diagrams are given as exemplifications of pieces of rough wood that can be reduced to planks or squared by the adze as may be found necessary. The dotted lines in each diagram show the cutting lines or lines to which the wood is to be reduced by the cutting action of the adze. In A is shown a piece of wood thicker at each end than in the middle; in B a second piece thicker in the middle than at the ends; and in C a piece of wood of about the same thickness throughout, but so irregular in form that it requires dressing on both sides. In D and E the pieces of wood figured in plan or section in A and B are shown in the solid for the purpose of exhibiting the grain of the wood, for on the direction of the grain much depends with regard to the manner in which the wood is to be cut. Thus in A or D, for both diagrams represent the same piece of wood, it is necessary to cut in two directions, namely, from the centre each way towards the ends. In B and E it is necessary to cut from the ends towards the centre. In cutting C it is necessary to work as in A for one side, and as in B in the other; in fact, it may be laid down as a general rule in using the "Bursoolah," when the grain does not run with the cutting line, that the cutting must be done against the curve of the grain.

So much for the methods to be followed in cutting plane surfaces with the adze. In Fig. 4 the manner of holding the adze when employed in the ordinary way for squaring timber or dressing surfaces. The thumb as shown in the illustration is placed on the back of the tool, and the fore finger is placed on the head, inside the angle formed by the portion terminating in the edge of the adze and the lower surface of the socket; the other fingers are closed round the haft immediately below the socket into which the haft is inserted. The haft passes along the lower part of the forearm. The work of cutting must be done from the elbow and not from the shoulder. In Fig. 5 the mode of holding the adze for doing rough work is shown. For this kind of work the haft is grasped in the same way as the handle of a common axe or hatchet, and in just about the same place.

Thus far Colonel Branson, to whom we are all indebted for the trouble he has taken in sending a description of the "Bursoolah," with the sketches that have been engraved and given here for the information of readers at home, and for giving welcome proof that AMATEUR WORK is read and valued in our Indian possessions as well as in other parts of the British Empire. As I have received the specimen adze which Colonel Branson has so kindly sent me through his agents, I have had it carefully figured, and give its dimensions in every part, so that amateurs who wish to have one made for their own use can do so. The chief thing that will militate against its adoption at home is that the amateur, unless he lives in the country has very little to do with logs, and the raw material in an unhewn state, and gets all his timber from the woodyard nicely sawn in planks and

squared. In the colonies, however, and to emigrants, it will be simply invaluable, and I think it would be most desirable for those who may be about to emigrate and go "up country" on arriving at their destination, to furnish themselves with a couple of these tools for rough and ready carpentry.

To return, however, to the measurements of the adze, these are shown as fully as possible in Figs. 6, 7, 8, and 9, which represent the iron head of the tool in plan, as seen from above and below, and in elevation, as viewed from the side and from behind. From the dimensions and sketches given, it will be possible for anyone to make a model in wood with the view of having one forged by a smith. The weight of the adze head is 2 lbs. 8 ozs. It is somewhat roughly made, as Colonel Branson hints, and bears the marks of the forging in every part, but in spite of want of finish it is a tool that may be said to be good, effective, and useful. The part shown at A in Figs. 7 and 8 is a projecting ridge about $\frac{1}{8}$ inch square, running along the junction of the planes of the inner sides of the part through which the handle passes, and those of the inner part of the bottom of the blade. The socket for the reception of the handle tapers slightly, as will be seen by the measurements from top to bottom, and into this socket the handle is slipped when the tool is in use. The handle is round and made of teak; it is $15\frac{3}{5}$ inches long, $1\frac{5}{8}$ inch in diameter at the upper extremity, and 1 inch in diameter at the lower end. I do not recognize the wood of which the log is made, but it bears some resemblance to English oak, and is as heavy, bulk for bulk, if not heavier. Its shape is shown in Fig. 1. It measures $12\frac{5}{8}$ inches long by $3\frac{3}{4}$ inches deep, and $3\frac{1}{4}$ inches wide. The distance from the left-hand extremity along the top to the commencement of the notch is $5\frac{3}{4}$ inches, and from the right-hand extremity along the top to the commencement of the notch on the other side is $2\frac{1}{4}$ inches. The left-hand plane of the notch is inclined to the upper surface of the logs at an angle of 125°; the right-hand plane is inclined to the upper surface at an angle of 145°. The length of the sides of the notch are respectively $2\frac{5}{8}$ inches and $3\frac{3}{4}$ inches, and they meet at the bottom at an angle of 40°.

The back of the adze, as Col. Branson remarks, may be utilised as a mallet and hammer, indeed, better so than the ordinary English hatchet or axe, which is not nearly so strongly made, and has considerably less thickness of iron at the handle. The weight of the tool and the round handle render it somewhat difficult to work comfortably with it when first commencing to use it, but this soon wears off, and those that adopt it will like it more and more every time they handle it.

AN EASILY-MADE CUTTER-BAR.

By J. L. DWYER.

THOSE amateurs who, like myself, give their principal attention to metal work, will, I have no doubt, endorse my statement, that by far the most important adjunct to a lathe is a good set of tools. Metal tools, too, are different to those for wood in many respects, and in none more than in the difficulty of sharpening them. To attempt to sharpen a blunt tool on an oilstone is almost a hopeless job. The usual size steel for tools for a five-inch lathe is $\frac{5}{8}$ inch square; and even the grinding of this is not pleasant. From the peculiar formation of the best cutting tools (Fig. 1), there is a limit beyond which grinding is impossible; they have then to be re-forged, and frequent forging destroys the steel. The height of centres from the tool plate has to be considered when forging a tool; and I have seen tools returned from the smith a full quarter of an inch too high. This had to be ground down, and at every successive grinding the tool edge was lowered, and therefore the tool had to be packed up. I leave the most important consideration for last, and that is, grinding tools to a proper angle. Some amateurs, especially the younger of us, can never do this successfully, and still it is very simple. When cutting, the tool should have a clearance of from 3° to 6°; *i.e.*, the angle made by a tangent to the work and the lower bounding line of the tool angle should be so large (see Fig. 2); but a thing very important, and of which we are apt to lose sight, is that the left-hand corner of the tool should also have a clearance angle; and if the tool is sometimes used the other way, both corners should have clearance.

The peculiar disadvantages of solid tools were brought to my mind very vividly some time ago, when I broke my grindstone, and had not time to rig up another. My attention was also directed to cutter-bars about the same time. I determined on trying one.

After studying my requirements and capabilities, I struck on the following plan, and produced a bar easy to make, and which has proved itself thoroughly efficient. I do not claim that it is thoroughly original, but I never saw one like it (except another I made since), although many are on the same general principle. The geometrical reasoning by which I came to my conclusions will be seen from Fig. 3. AC is the plane of the tool plate; CD a perpendicular from it; DCF, 63°, *i.e.*, 60°, the best cutting for iron, plus 3° clearance; GD a perpendicular to CF. Since FCD and FGC are both complements of GCF, they are equal, and therefore CGF is 63° and AGD is 117°.

I made a template to that angle. To do this, get

a piece of tin, describe a circle on it, and then put the leg on any part of the circumference M, and from it measure two radii, A B, Fig. 4, join the points with the centre, and we have 120°. Three degrees less can easily be guessed. Cut along the straight lines D C, C B, and we have the template.

For my bar I used ½ inch square steel, heated it, and bent it in the vice to the shape shown (Fig. 5). Having been filed up nice and square, it was laid on a piece of planed board, and a pencil run round it.

The slot, which is the most difficult part, did not try me as much as I expected. I managed to bore three holes through, and cut the metal between with a little chisel : a file finished the job. Of course, the slot must be at right angles to the surface of E F (Fig. 5). This can be tested by putting a piece of iron or steel through, and using a square. The set screw is made from a piece of ½ inch round steel, turned down for a length of ⅜ to $\frac{3}{16}$ inch diameter, and threaded ; a hexagonal head was filed to fit a

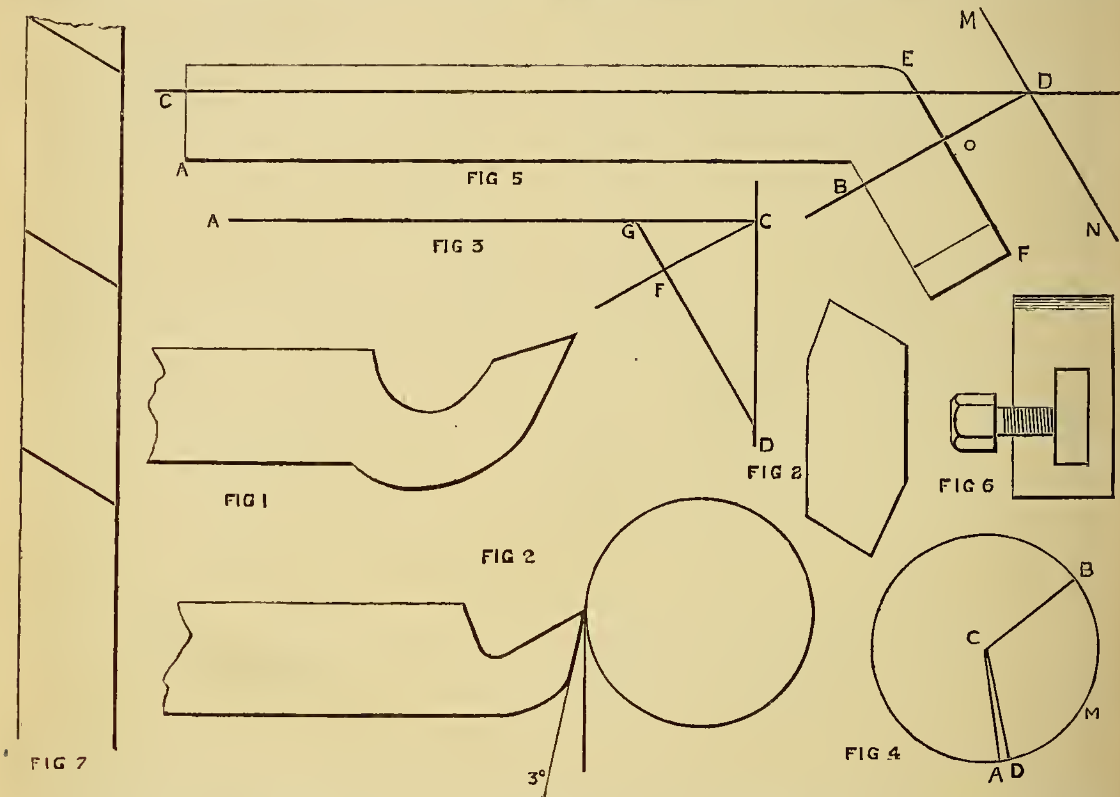


FIG. 1.—FORM OF BEST CUTTING TOOL. FIG. 2.—CLEARANCE OF TOOL. FIG. 3.—DIAGRAM ILLUSTRATIVE OF PLAN ON WHICH BAR IS MADE. FIG. 4.—TIN TEMPLATE. FIG. 5.—FORM OF BAR IN THE ROUGH. FIG. 6.—SET SCREW—END VIEW. FIG. 7.—STEEL FOR CUTTERS. FIG. 8.—FORMATION OF POINT OF TOOL AT ANGLE OTHER THAN 60°.

A line, C D, was then drawn parallel to A B, and ⅜ inch from it; that is, the distance from tool plate to lathe centres. A line, M N, was also drawn parallel to E F, and half an inch from it. A perpendicular was drawn from D, where these lines cut to E F. The distance from E to O was carefully measured on the metal, and the point O marked. This was the upper limit of a slot cut through the bar. It will be seen from Fig. 6, that this slot, ½ inch long by $\frac{3}{16}$ inch wide, is not in the middle of the bar, being $\frac{1}{16}$ inch full from one side, and ¼ inch slack from the other. This is to allow of cutting close up to shoulders, and also to afford more thread to the set screw.

spanner. The point of the screw I hardened by covering the bottom of a plate with water about ⅛ inch deep, and dipping the point in—when hot, of course. It is well, when making the slot, to have the tool steel at hand, for fitting purposes, so that no filing need be done to the sides or edges of the cutters.

The manufacture of these cutters is a very simple and rapid operation. A piece of steel (Fig. 7) is taken, and pieces cut off at an angle of 60°, 1¼ inches long, and the edges then get a few rubs to make them round-nosed, square, or any other desirable shape; they are then tied together with binding wire, put into the fire, plunged into water or oil when a bright

red, rubbed on a stone for a bit to brighten the side, and held over a spirit lamp or Bunsen's burner until the desired temper is reached. I usually bring them all to a light straw colour.

If a blunter angle than 60° is required, it can easily be got by filing off the point of the tool as required (Fig. 8), and different sets of tools may be kept for brass, cast iron, steel, etc. The tools can be elevated or depressed by pushing out or drawing in the bar.

This paper may be appropriately closed with a list of the cutting angles for different materials, the clearance being in all cases from 3° to 6°.

Angle.	Material.	Angle.	Material.
60° . .	Iron and Steel.	80° . .	Roughing Brass.
70° . .	Cast Iron.	90° . .	Finishing Brass.

THREE USEFUL BAGS, AND HOW TO MAKE THEM.

By JOHN T. HUMPHREY.

SINCE the papers on "Boot and Shoemaking" in Vol. I. of AMATEUR WORK, Illustrated, I think nothing relating to the leather trades has appeared in it; and as there must be many amongst the readers of this magazine who have a desire to dive deeper into the art of manipulating leather into the various articles of utility made from that material, I will endeavour in the series of articles, of which this is the commencement, to furnish them with the necessary instructions, which will enable them to do for themselves many things which now are left undone, or else have to be conveyed miles to some town where the particular business, or something akin to it, is carried on. To the colonist and those who live in out-of-the-way districts, it must be a matter of great regret to observe articles of use where the material is in good condition rapidly becoming useless owing to the inability of the possessor to do the necessary repairs. Again, it may be that the article is completely worn out, and the old proverb, that "A stitch in time saves nine," will not be advantageously applied if carried out. In that case, a knowledge of making new what we require, whether in order to replace something already worn out, or as an addition to our store, must prove beneficial to the thrifty amateur. My object in writing these articles is not to deprive the mechanic of any portion of his legitimate occupation, but to assist those who live at a distance too great to be able to employ him, and who necessarily prefer any makeshift to the inconvenience of sending miles and being without for days, an article which might possibly be set right in an hour or two.

I propose to deal first with bags, the *modus operandi* being so simple as to be quite within the powers of the ordinary amateur to accomplish, besides giving him a little elementary knowledge of the leather trades generally. Bags of various kinds are made according to the use they are intended for. Foremost amongst these we have the old-fashioned Carpet Bag, Fig. 1, still unsurpassed by any where rough wear is the principal thing to be studied. Such a bag, if constructed of good Brussels carpeting and unquestionable workmanship, will last a life-time, providing always that a substantial frame is used.

Next in order comes the Brief Bag, Fig. 2, more extensively used than any other. For business purposes it is in great favour with bag-users, being made in a variety of shapes, but all belonging to the same class. Here we have the Shallow Brief, Deep Brief, Eclipse Wide-mouth, Imperial Wide-mouth, Excelsior, Courier, and many others; but to know how to make one will be sufficient for all, the only difference being in the cut or style in which they are constructed.

It would be useless for me to go into the making of ladies' and fancy bags, because the frames and fittings can only be purchased wholesale. They are manufactured in France and Germany, and are sent to the bag manufacturers in this country direct from abroad. At one time England used to do her share of this branch of the trade, but owing to the keen competition indulged in by our continental brethren, it has entirely slipped away from us, adding another item to the loss sustained by our British industries.

The Cricket-bat Bag represented in Fig. 3, is made on the same principle throughout as the Carpet Bag.

The "Gladstone" Bag, especially adapted for travellers, will form the subject for a future chapter.

Frames and all necessary fittings required in making Carpet, Brief, and Gladstone Bags, may be purchased of Mr. Hudson, 93, *Milton Street, Chiswell Street, London*, whose manufactory is in Birmingham. Frames vary in price according to size and quality. Those used for carpet or American cloth bags, from 10 inches to 14 inches, cost 4d. each; from 14 inches to 18 inches, 6d.; above that size, 8d. A 36 inch, suitable for a Cricket-bat Bag, costs 1s.

Brief Bags are made on two or three kinds, the most popular being called a "Registered Frame," and having fittings in brass or nickel. The lock has double action, a long cylindrical barrel passes through the centre of the lock, the uppermost end of which protrudes through the frame above, and the lower end is encased by a spiral spring. By depressing the barrel two claws at right angles to it are carried below the openings in the casing of the lock, through which a double hasp fixed to the other half of the frame enters. By removing the pressure the spring

forces the barrel back into its place, and the claws enter the hasp, which fastens the frame. A key way is cut through the centre of the barrel, by which it can be locked, if desired. The other kinds used are the same as those mentioned for Carpet Bags, and one similar, with the addition of a small spring on the frame above the lock, which is a slight improvement on the old method of lock and key, but cannot be compared to the "Registered."

A Carpet Bag will be the easiest to commence upon and pave the way towards accomplishing greater things being made of a material easy to work and not requiring that finish and neatness in manufacture so necessary to one of leather. No doubt many amateurs who have their carpets made at home will have a ready supply of pieces suitable for bag-making from the remnants which at one time or another have been relegated to the lumber room to await being used for repairs or pass into the hands of the rag collector. Those who have not such remnants by them must go to a piece-buyer, or upholsterer, where it is most likely they can obtain what they require for a trifle. On no account purchase by the yard from the roll, it would be too expensive, unless a very cheap one was bought, and this would soon wear out. Care must be observed in choosing all the pieces necessary for a bag from the same pattern carpet, otherwise it will present an unsightly appearance when completed. There may be some who would prefer American cloth; this is thoroughly waterproof, and has a good appearance for some time, but like all articles of imitation, it has only *cheapness* to recommend it. If cloth is to be used (I mean American cloth) let it be the best that can be bought, that which is called "Double-twill Duck," if possible. As the making is the same, whether cloth or carpet be used, it will be understood that the instructions for making apply to both.

The following tools, which are few and inexpensive, will be required:—A pair of clams (Fig. 4), cost 1s. 6d.; knife (Fig. 5), 6d.; half dozen awl-blades, ½d. each; three or four boxwood handles, 1½d. each; 3 foot rule, 1s.; hammer, 1s.; a packet of harness needles, size 4, cost 2½d. (these have blunt points); a bone (Fig. 6), will also be required for rubbing the stiffenings into place, cost about 3d.; and a ball each of hemp and wax for making the sewing threads—hemp, 2½d., wax, ½d. For making holes in the bottom where the nails or studs are fixed a large sewing-awl will be required; this will probably have to be bought at a saddler's; the other tools can all be obtained at any grindery and leather-seller's.

The awl blades mentioned above are of two kinds, and either may be used for this work. Those generally used are of a straight diagonal shape, making a perforation the shape of a diamond ◊, the others are perfectly round, tapering gradually to a fine point. To fix them in the boxwood handles, place the blade in a vice, leaving the unpolished part above the jaws, hold the handle above this and commence driving it down, taking care that the blade is penetrating the middle of the handle. Continue tapping the handle until the ferrule reaches the polished part of the blade, it will then be in far enough.

A good serviceable pair of clams may be made by taking two staves of a good-sized barrel and cutting about 10 inches off the end of each. Screw together with three screws, as in Fig. 4, and shape the uppermost ends so that the outsides meet in a sharp ridge along the top, this will give a flat surface within the mouth, by which a hold of the work may be obtained. A two-inch screw will be long enough for the bottom, which must be turned in as tightly as possible, the others must not be less than 3 inches, as there will be a space of 1½ or 2 inches between the staves at the part where they are inserted. Screw these just tight enough to give a good sharp spring to the mouth of the clams when they are pressed open, this will ensure the work being held firmly while being sewn. Sandpaper them over to give a smooth appearance, and these will be found as useful as bought ones.

A piece of basil leather will be required for the bottom and welts of the bag. This may be purchased at a leatherseller's with the tools. Cut out the bottom first, the welts may be cut from any narrow pieces. These must be cut seven-eighths of an inch wide, then folded over, and lightly hammered down. This brings the two edges together, and when placed in position they should lie evenly between the edges of the material. A piece of string may be laid in the welt to give it a fuller appearance if the leather is very thin.

The following dimensions of bags when made up will enable the maker to choose the most useful size:—No. 1, 16 by 14 inches; No. 2, 19 by 16 inches; No. 3, 21 by 17 inches; No. 4, 24 by 18 inches.

The sizes of frames and parts when cut will be as follows:—

	Frame.	Sides.	Bottom.	Gussets.
No. 1.	15 inches...	16½ by 15½...	16½ by 5½...	15½ by 5½
No. 2.	18 inches...	19½ by 17½...	19½ by 6 ...	17 by 6
No. 3.	20 inches...	21½ by 18½...	21½ by 6½...	18½ by 6½
No. 4.	23 inches...	24½ by 19½...	24½ by 6½...	19½ by 6½.

Taking No 1, 16½ inches will be the length of sides and 15½ inches the depth. The gussets are also 15½ deep, the width being 5½ the same as the bottom. Take 1½ inches from the depth of these to allow for covering the frame, and ½ inch from the length to allow for the seams, and we have a bag 16 inches long by 14 inches deep.

And now to commence. Arrange the pieces of

carpet on the board, and mark off the size of each part required with a piece of chalk or pipeclay. By cutting with the carpet, laying the right side up, we shall be able to see that the pattern of it will be in the same direction on both sides of the bag when made up. We next take the ball of hemp, and by pushing the finger through the hole in the centre of it drive out the end. To use the hemp from the inside is much the best way, because the ball will stand perfectly still, whereas, if started from the outside, it will be darting in all directions about the floor of the workroom, and entwining itself around any obstacle which lays there, unless it is placed securely in a box and drawn out through a hole in the centre of lid. A hook must be fixed in some convenient place to make the waxends on, or, as they are called in the trade "threads," which term it will be as well to call them by here; thus a *four-cord thread* means a thread or waxend containing four strands of hemp, a six-cord contains six strands, and so on. One of the greatest difficulties for the amateur is to produce a well-formed thread, he generally finds it thicker a few inches from the point than at any other part. These are known in the trade as bull-necked threads: and as the mechanic finds it difficult to use them when his employer starts a new apprentice and gives him this job for the men, I must impress on the worker here the necessity of making them as perfect as possible. It would be as well if a little practice was given at breaking the hemp in the way which produces good points. Better waste a few yards of hemp than be compelled to abandon a thread after making only a few stitches with it. Grip the hemp firmly between the thumb and forefinger of the left hand, leaving about 8 or 9 inches hanging loosely down, lay this over the thigh of the right leg, and with the right hand rub it in a downward direction which will cause the twisted strand to loosen. One good stroke should be sufficient, if not it must be repeated until the fibres forming the strand are quite loosened. By holding it close to the end with the right hand, and giving it a jerk with the left, the fibres will break, and the ends of the strands formed in this way are placed at a little distance one above another which when twisted form a smooth tapering point. To cast off a thread the proper way is to stand at a distance of about 3 feet from the hook previously mentioned, and by holding the end of the hemp in the left hand pass it over the hook and bring it down with the right, then holding with the left and breaking as above. When sufficient strands to form the thread have been broken off, carefully examine the points to see that they taper properly, and have no lumps in them. Rub the wax up and down a few times, so that the thread may be properly waxed on that portion which will be inside when twisted. Hold the two ends in the left hand, and with the right roll each end separately down the right leg a sufficient number of times to twist the thread throughout. Judgment will be required in this operation, or the thread will be a constant source of trouble if it is over-twisted. Wax it again, and then it is ready for use. See that the points are well waxed, then take a needle and pass the point of the thread through the eye until it nearly reaches that part which would stop its progress.

It must now be turned down on to the thicker portion and carefully twisted. Smooth it down, then take the other end of thread and another needle, and fasten it on in the same way. In selecting the awl to be used do not take a very large one, the hole should be just large enough for the thread to require a slight pull to get it through.

To commence sewing take one side and a gusset and place them evenly together, the right side of the material being inside, and fix them in the clams. Slip the welt as previously described between the edges, and pass the awl through the lot. Drive it perfectly straight, as upon this chiefly depends a nice seam when turned. Draw out the awl, and by following the point pass up the bottom needle with the left hand; this should be taken by the thumb and forefinger of the right hand and the thread pulled through half its length, so forming a thread of equal length on each side. Make another hole with the awl about one-third of an inch from the first, this gives the length of stitch. Pass up the bottom needle as before into the right hand, the top needle descending to the bottom immediately after. Take hold of this with the left hand and pull through the threads simultaneously top and bottom until the extremity on each side lays on and forms the stitch. Be careful that in pulling in the latter part each thread closes at the same time, thereby preventing a crooked seam. Repeat until the seam is finished, then take the other gusset and place in position. Sew this, then take the other side of bag and sew to the gussets. You will then have something in the shape of a bag minus the bottom. Take this next, and fix each corner to one of the seams previously made, and stitch it carefully round, placing a welt in as before. At the end of each seam a stitch or two back should be taken or the thread tied over to prevent it opening.

The outside of the bag being inwards, it must now be turned previous to stiffening and framing. The turning is done by placing the bag over the left arm, and with the right hand commence pushing in one of the corners, then the opposite one until that end is reversed. Then serve the other end in a similar manner, and smooth each seam along.

We now take a piece of stout millboard (an old

ledger book-cover will do if large enough), or, if purchased with the frame, ask for a two-pound board, this will cost about 4d. and be sufficient for several bags, cut it quarter of an inch less than the bottom all round, and see that it fits before gluing it in. To do this place one end within the seams at one end of the bag, and by lifting it in the middle press in the other, when the stiffening will lay within the four seams at the bottom. Having fitted it satisfactorily, take it out again and glue it well with some good hot glue. This must be neither too thick nor too thin; the best way to prepare it is to lay some glue in cold water for twelve hours, it will absorb sufficient water in that time and can be boiled up without any further preparation. The quicker it is fixed after the glue is put on the better. A brush similar to a paint brush will be the best to apply it with, and need not cost more than 6d. After the gluing lay it aside for a few hours to allow it to thoroughly set, during which time the making of the handles can be proceeded with. On some bought bags these are very common, and seldom last more than a few months; the usual plan being to take a piece of rope about the size of clothes line and roll a piece of brown paper round it, covering it afterwards with a piece of basil leather.

FIG. 1.—THE CARPET BAG.

Procure two pieces of brown harness leather—the shoulder of the hide is most suitable—from a saddler, 11 inches long by $1\frac{1}{8}$ inch wide, round the four ends, and make a compass mark $\frac{1}{8}$ of an inch from the edge all round for the stitching. Take a piece of line as above, and place within the leather, which most likely will have to be damped to make it draw round easier. Leave $1\frac{1}{2}$ inch from each end for sewing to the bag, the line also being so much less than the full length of the handles. Having sewn them, flatten the ends and bend the handles into a semi-circular shape, and leave them to dry. By this time the glue holding the stiffening to the bottom of the bag will be set, so the next move will be to put in the studs or nails. Take the largest size awl and make five punctures through the bottom about $\frac{3}{4}$ of an inch from each corner and one in the centre, as in Fig. 8; push the nails through and turn down each of the two claws in an opposite direction, tap them with a hammer to make them lay closer, and also to prevent them becoming loose. This done, we next take the frame and remove the key-plate from it. Fold the sides of the bag well over the frame, so that the stitching will get a good hold of the part that goes inside. Put a stitch through at each corner to hold it, and see that it sets perfectly true on the frame. A space is left between the two plates of iron forming the frame, which allows of the bag being sewn through it. Fix the key-plate by riveting inside. Sew the bag from one corner of frame to the other corner on each side, leaving the gussets unstitched. It is now ready for the lining. Let this be good, as it will greatly add to the durability of the bag if strong. Coarse linen at 8d. to 10d. per yard, is the best material for this purpose. The sides and bottom may be cut in one piece; the length of this will be twice the depth of one side of carpet (less the part which folds over the frame) and the width of the bottom. The width of this piece throughout to be half inch less than the outsides were cut. The gusset lining will want to be the same width as the gusset, but an inch less in length will do. The seams of the lining may be stitched with an ordinary household sewing machine if good thread is used. When made, place the lining inside the bag, see that it is well down at the bottom, turn in the top edge all round to the required size, and fix in as follows: Take a long carpet needle and a length of thread, pass the needle through the

FIG. 2.—THE BRIEF BAG.

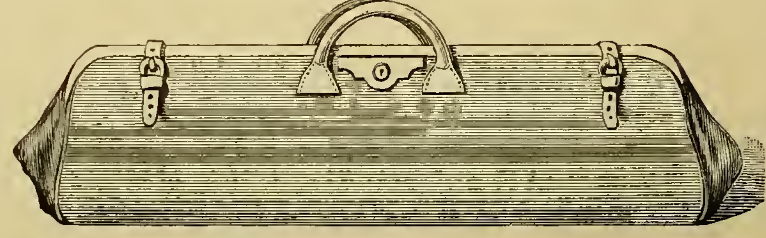


FIG. 3.—THE CRICKET-BAT BAG.

lining at the folded ridge and bring it up again through the same at a distance of an inch or so. This forms a stitch within the lining; pass the needle through one of the stitches made in sewing in the frame and repeat as before, carefully observing that the lining falls into its proper place as it is being sewn in. Continue in this way until the two sides are done, leaving only the gussets and gusset lining to be united. This is done by folding the edges inwards and sewing them together, the frame joints moving freely between the gussets and lining. We have now only the handles to put on and it is complete. Sew these on with a five cord thread well waxed.

is a strong, coarse material of a brown colour; it wears well, and has one advantage over carpet—it is thoroughly waterproof.

Leather is, of course, superior to carpet or canvas, but there are a few tricks in its manufacture which it may not be out of place here to mention as a caution to the amateur that the old saying, "There's nothing *like* leather," is a thing of the past where the general appearance of an article is meant. The genius of the inventor has produced machinery which gives to paper, linen, and other stuffs the appearance of the genuine article, whereas, it does not contain one particle of it. At one time, when a hide of leather

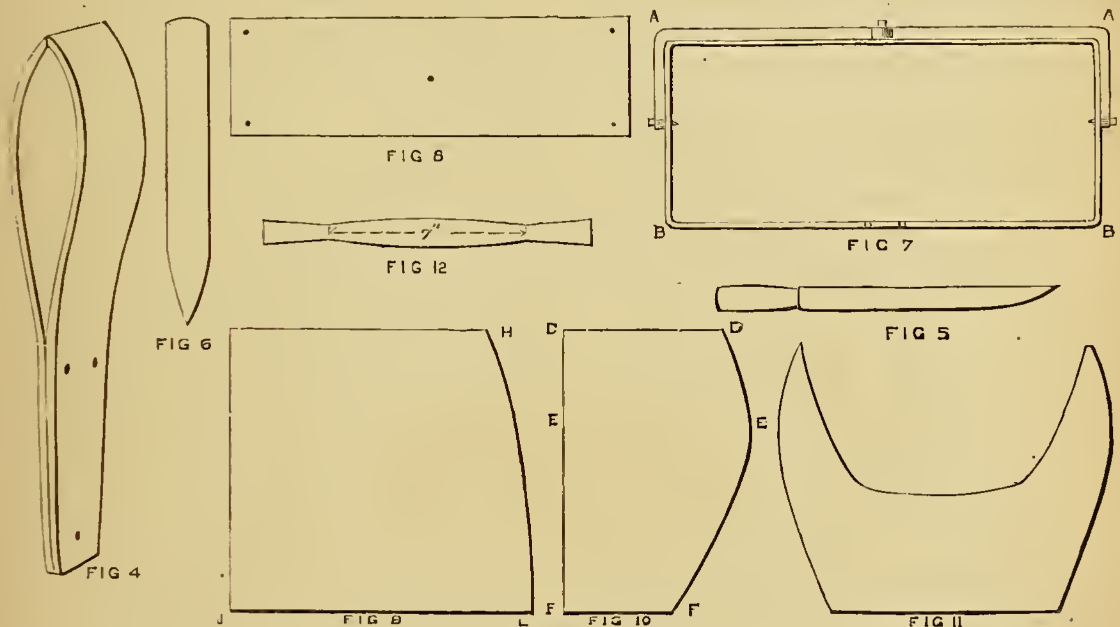


FIG. 4.—PAIR OF CLAMS. FIG. 5.—KNIFE. FIG. 6.—BONE RUBBER. FIG. 7.—METHOD OF MEASURING REGISTERED FRAME; A to A, Top of Sides; A to B, Top of Gussets. FIG. 8.—PATTERN OF BOTTOM, SHOWING PLACE OF NAILS. FIG. 9.—SIDE PATTERN FOLDED. FIG. 10.—GUSSET PATTERN FOLDED. FIG. 11.—PATTERN FOR GUSSET STIFFENING. FIG. 12.—HANDLE, SHOWING DISTANCE OF RINGS.

To protect the lock against being unduly strained when filled, a strap and buckle may be put on between the handles and each end of the frame, as in Fig. 3.

Next in order is the Cricket-bat Bag, which should always be comprised in the outfit of the amateur cricketer, as well as of the professional. In making this we follow the instructions given for the Carpet Bag. It may be made either of carpet, tan-canvas, or leather, the latter, of course, being the strongest and most expensive. Carpet will not require to be described, but a brief description of tan canvas and leather may be of service to the amateur in assisting him to choose something for himself.

Tan-canvas, as used for bags and portmanteaux, was required to be of the same thickness all over it, the currier would work at the flesh of the skin with a shaving knife, gradually scraping the thick parts away until it was reduced to the required substance. Now it is done in a few minutes. The hide is passed whole between the rollers of a splitting machine against the sharp edge of a knife, which reaches from one side of the machine to the other, a distance of 10 or 12 feet. This knife is so gauged that any thickness can be taken off at one operation, the part taken off resembling the hide in size and shape. The top or grain of the hide is then dressed and finished off brown, if for brown hides; or, if to be used for enamelled hides, they are dyed and japanned. These are called either brown or enamelled cow-hides, according as they are finished off, and are used for

all the best class of Gladstone, Brief, and other bags. The bottom, or fleshing of the hide, is also dyed and japanned, and when finished, exactly resembles in appearance the hide itself, and is very difficult for the novice to tell when made up into bags or any other article. These are called *splits*, and having had the best part of the skin taken from them, do not wear one-fourth the time the grain will, the black enamel soon chips off, which gives them a worn-out appearance.

To make a bag 36 inches by 12 inches by 8 inches requires a frame 36 inches long, the sides 36½ inches by 14 inches, gussets 14 inches by 8½ inches, bottom 36½ inches by 8 inches. The lining will be 36 inches by 12 inches for the sides, gussets 13 inches by 8 inches, bottom 36 inches by 8 inches. For the handles two pieces of leather 12 inches by 2 inches. The straps and chapes are sewn on quite close to the frame, straps 10 inches long by 1 inch, chapes 4½ inches by 1 inch. Cut a slit in the middle of the chape for the buckle tongue to go through, and pare the underside at the end so that it is not too lumpy when sewn on to the bag. Cut two loops 3 inches long by ¾ inch wide for the points of straps to go through.

The Brief Bag must be made in leather, and as there is the same amount of work in making it, whether it be of split or hide, it will be sure to give greater satisfaction if the latter is chosen. The manufacture of this bag differs considerably from the others. The sides and gussets in the Carpet Bag are cut straight from top to bottom, but in the Brief Bag they must be shaped to fit the frame and give it a more comely appearance. The frame, as before described, is quite different. The way to commence with this bag is to open the frame as in Fig. 7, so that it will lay perfectly flat upon the bench. With the rule measure it carefully between the corners A, A, and again at A, B. The distance between A and B being less when the frame is open than when closed, an additional ½ inch must be added to allow the gusset to bend freely round the hinge. Having correctly taken these measurements, get a sheet of brown paper and fold it in the middle; the reason for this is to allow of each side of the pattern taking the same curve at the swelled part. Cut the pattern for the sides first by ascertaining half the distance A, A, and marking it on to the edge of the paper, measuring from the folded edge towards the ends. Next mark on the folded edge the depth you intend the bag to be, allowing in this as in the Carpet Bag 1½ inch for covering the frame. The depths of Brief Bags vary so much that I will give these only as a guide, leaving my readers to add or reduce as their fancy guides them; but if they should strictly adhere to these given below I am certain they will find them very useful sizes.

For a 12 inch frame cut the sides and gussets 10½ inches in depth; when made up these will be 9 inches from the frame to the bottom. For a 14 inch frame add 1 inch, and for a 16 inch add 2 inches. This will make these 10 inches and 11 inches in depth respectively when made up, and either of these will be found a very useful bag for many purposes. The width of the bottoms to be cut 5 inches, 5½ inches, and 6 inches, the 5 inches, of course, for the 12 inch bag, the 5½ inch for the 14 inch, and the 6 inch for the 16 inch. The depth having been decided upon, and marked on the folded edge of the paper, make another mark the same distance from the edge at the first mark H. The bottom of the sides being 1 inch longer than the top, add ½ inch to the measurement of the top of pattern when the bottom part is marked off at J L. Draw a curved line between H L, as in Fig. 9, and cut through the two thicknesses of paper at one time, keeping them well together to insure them being alike. The gusset pattern may be cut in the same way, D to D, Fig. 10, being half the distance of A B, Fig. 7, and the ½ inch added for going round the joint; E E, the swelled part, which bends into the bag when the frame is closed, and also allows it to open perfectly square; F F is half the width of the bottom of gusset. A pattern for the bottom of the bag may be made by folding a piece of paper each way to get the length and width, make a small hole through the four thicknesses; open it and mark it from hole to hole, using the rule as a guide. This will be found to be perfectly accurate.

To cut out the bag, lay the leather on the bench, enamelled side downwards, and see that the patterns lie on it so the creases will run from the top to bottom of the bag when made. The sides must be taken first, and as they are more exposed than any other part, they should be taken from the best part of the hide. Take the gussets next, then the bottom. The welts are taken from the cuttings which are left. To make the handle, glue a lot of odd pieces together about 6½ inches long, ½ inch wide, and the same thickness, and when dry pare the edges away until it is perfectly round and slightly tapering towards each end. It is then divided and glued top and bottom to a strip of good leather cut to shape, Fig. 12, which is passed through the rings at each end, and turned back to form a shape. Put a few stitches through close to the rings before the fittings are glued on, and cover with a piece of cow-hide long enough to go through the two rings and along the underside, then stitch it. Trim and dye the edges, rubbing them afterwards with a piece of cloth to produce a polish. Before making the handle the plates must be on the

rings or it will prove a difficult job to get them on afterwards.

The stiffening for the bottom will be cut as if for a Carpet Bag. Fig. 11 represents the stiffening for the gussets, and is cut from a board half the thickness of that used for the bottom.

The linings may be cut from the outside patterns by reducing tbem tbe $1\frac{1}{2}$ inches allowed for covering the frame, and $\frac{1}{8}$ inch for each welt. A lining of scarlet or blue roan greatly adds to the appearance and durability of a bag. A skin large enough for a 14 inch or 16 incb will cost about 3s.

Cow-hide for the outside is sold at 1s. 8d. per square foot, but the leather-sellers frequently have pieces large enough for making a bag which they will sell at a slight reduction, and which answers this purpose as well as cutting a hide. In seaming the bag take care not to wrinkle it in the clams. The welts in this must reach only to the frame, the same as in tbe Carpet Bag, the rest of the seam must be neatly closed and rubbed down so that it will not be lumpy on tbe frame. Before turning the bag warm it before the fire, especially if it is cold weather. Glue in tbe bottom stiffening first, and then the gussets, rubbing them well down with the bone. When these are set, prepare for the operation of framing. Fold one of the sides to get tbe middle of it, cut a hole for tbe lock barrel about $1\frac{1}{4}$ inch from tbe edge, and press it over. Be careful not to cut it too large or the hole will show. Pierce a hole through the leather for tbe lock plate, press tbis tightly on the frame, and clench the clams underneath to hold it securely. Make holes for the handle plates and fasten them on in a similar manner. Two slits must be cut near the middle of the other side of bag, about $\frac{3}{4}$ inch from tbe edge for the hasp to go through. This bag must be sewn to tbe frame all round, and care must be taken that a sufficient fulness is allowed in tbe middle of the gusset to enable it to close easily round tbe joints of the frame. A thumbpiece must be sewn on the bag at tbe hasp to open it by. Tbe lining of this bag is sewn through the frame all round in tbe same manner as the side linings of the Carpet Bag.

I hope my readers will not think that I have gone too much into details. It is in small things that so many failures take place. As it is much easier to do anything when you are shown than when so much has to be guessed, it is my desire to make the road for beginners as smooth as possible, which must be my excuse if any is required. It is as well that those who intend to turn their attention to working in leather should begin by making a bag: the experience gained in cutting, fitting, putting togetber, and finishing will be useful when larger and more difficult pieces of work are undertaken.

THE REFLECTING TELESCOPE:

ITS CONSTRUCTION AND MANUFACTURE.

By EDWARD A. FRANCIS.

XI.—THE POLISHING OF THE SPECULUM COMPLETED—THE PROCESS OF SILVERING THE GLASS.

IN the last chapter it was shown how to deepen the centre of a speculum for the purpose of shortening the inner rays, by cutting away the pitch towards the edge of the polisher. Some remarks were also made as to the inadvisability of mutilating the polisher for any other purpose. This leads us to consider another system of figuring—"local polishing." The term is self-explanatory. If instead of graduating the polisher from centre to edge, all the pitch except the half-dozen central facets was removed, and the polishing then continued, the glass would only be cut away in the locality of the centre, and the same effect would be produced as if the speculum were placed face uppermost, and a little pitch polisher were rubbed over it near to the centre. Or, again, if a mirror were ascertained by testing to possess an hyperbolic curve, having a section similar to Fig. 66, it would be necessary, as indicated in the last chapter, to polish away the hills A, A, until the section was *nearly* flat and the mirror parabolic.

And if Fig. 67 be taken to represent the concave face of such a mirror *not* under test, it would be necessary to polish for the time being mostly on the darkened portion. Following our ordinary method, we should move the mirror over a complete polisher with a stroke of a length equal to the distance A, B; but, if instead of so doing, we were to cut away the pitch from the polisher, so that the only part left untouched would be a ring of pitch occupying a similar position on the glass base of the polisher to that occupied by the shading in Fig. 67, the hills would be polished down more quickly. A polisher so prepared would present a section similar to Fig. 68, and it may be easily seen that if the speculum were to be moved with short strokes over such a polisher, the part of the mirror represented by the shaded zone in Fig. 67 would alone be polished away.

Similarly the polisher could be altered—by either reducing the size of, or entirely removing, certain facets—so as to polish only any given part of the mirror. Such would be local polishing. To reduce the hills A, A (Fig. 66) for example, a smaller polisher would require to be made of a diameter about equal to the width of the zone, and the speculum having been placed face uppermost upon the bench, strokes would be taken with the small polisher, in straight

lines across the zone to be reduced in every possible direction, so as to equalize the abrading action. This would have a similar effect on the curve to the device shown in Fig. 68.

Or if it were required to parabolize a spherical mirror (by deepening the centre) by this process of local polishing, several polishers would be made. The first one about 3 inches, the second about $4\frac{1}{2}$ inches, the third about 6 inches in diameter. They would be used in order of size, being moved in straight or nearly straight strokes, over every diameter of the speculum, which, of course, would be lying face uppermost. The smallest polisher would act most on the centre, the larger one would carry the correction a little farther, and the largest would complete it to the edge. The great danger in this local polishing is, that when the polishers overhang the edge of the speculum they may, by reason of their weight, unduly wear it away, and so cause the mirror near to its edge to be useless. The base of these small polishers may be made of metal or of glass, or of two discs of wood screwed together with the grain crossed, and then turned to the required curve on one surface, a little handle being attached to the back.

This method of working is not to be recommended for a beginner, or in any case for a small surface: it requires a considerable practical knowledge of the art of speculum polishing; but should it be deemed advisable to attempt it, or if in any other way the general truth of the curve of the speculum is disturbed, it can be regained by reworking the speculum face downwards on a complete polisher made after the fashion of Fig. 35. It should be remembered that the shadow test would indicate where the local polishing action should be applied.

My readers should be cognizant of as many direct methods of figuring the speculum as possible, so that they may have a greater chance of first success; therefore this study of polishing shall be concluded with a short description of the process followed by a successful speculum-maker, who lived before the modern silver-on-glass reflector was known.

Mr. John Mudge, one of the amateurs who fostered the art of reflecting telescope making in its infancy, obtained a parabolic figure to his mirrors by the following plan. Firstly, he worked with very short circular strokes. These short strokes, he noticed, always caused the polish to begin in the centre of the metal, because the pliable polisher assumed a curve of a smaller sphere than that required in the speculum. The fact of the polish beginning in the centre first, proved that the speculum was being worn away most at the centre, and it has been shown that to deepen the centre of a spheric mirror in a very slight degree is to render it parabolic. So that Mr. Mudge continued working in this manner with short circular strokes until the polish was complete, when experience told him that by that time he had deepened the centre *too* much. He then resorted to short straight strokes to bring the curve back again to the sphere. Having attained that object (experience was his only guide) he resorted again to the short circular strokes for two minutes, by which time he considered the spherical concave had again been worn down centrally, sufficient to make the curve parabolic. He has left on record the fact that the short circular strokes never caused the speculum to move more than $\frac{1}{2}$ inch or $\frac{5}{8}$ inch over the edge of the pitch polisher.

Of the elliptical polisher which was used right up to Sir John Herschel's time, there is little to say. The reader will readily see (referring to Fig. 13) that if a stroke be given during the polishing, which would on an ordinary polisher produce a sphere; on such a polisher as that indicated in the figure it would produce a parabola, for the excess of polishing surface at B, B would abrade the glass a little more towards the edge than at the centre, and so lengthen the outer rays and form the parabola.

The same end would be obtained if, as is often done at the present day, the pitch polisher be made circular, but very slightly larger in diameter than the speculum is.

The figuring is now completed. There are one or two minor tests which we shall consider when the telescope is mounted; but first we must discuss the process of covering the polished glass with silver, and the manufacture of the little plane speculum. A rough and ready mounting may then be described, and the construction of the eye-pieces, in order that our specula may be put in use while the more elaborate mounting necessary to work *comfortably* is being considered.

Perhaps it may be said, however, that if during the shadow testing a low power eye-piece mounted upon a suitable stand be substituted for the metal screen (Fig. 42), the curve of the speculum may be roughly ascertained by the appearance of the image of the tiny aperture in the lamp shade when examined with the eye-piece. If the mirror be truly spherical, the magnified image of the artificial star will be perfectly defined, and it will be capable of being sharply focussed. (It must be remembered that the eye-piece is simply a microscope by which the image of the aperture is magnified.)

If the mirror has an oblate-spheroidal curve, the illuminated aperture will not admit of fine definition, but will be surrounded by a halo of false light, which halo, however, will be sensibly diminished if the eye-piece be moved slightly *towards* the mirror.

The same appearance will be noticeable if the speculum be of an elliptic, parabolic or hyperbolic curve, but the eye-piece will then have to be slightly moved *from* the mirror to reduce the halo of light which surrounds the image at the point of best definition.

One other fact may be stated. If the experimenter watches the surface of the mirror when the screen is being moved across the rays at the centre of curvature, he will be enabled to indicate the paths of the rays on paper, and so prove his deduction of figure. If, for example, in Fig. 69, A B, be taken to be a section of the mirror under test, and S to be the screen when half way across the cone of rays at the centre of curvature, and C, C, parts of the concave surface appear shaded, it is a proof that the rays from C, C are cut off from the eye by the screen, as drawn. Similarly because D, D, other parts of the surface, remain bright, it is evident that the rays from those parts escape past the screen into the eye, and if these latter rays be indicated it will be also evident that the outer rays are longer than the inner, and that the mirror is possessed of an hyperbolic curve, as the shading will prove, if the reader sketch out an imaginary front view of a speculum under test, having the portion C C shaded and D D bright. This is a crude example, but it will serve to elucidate the method.

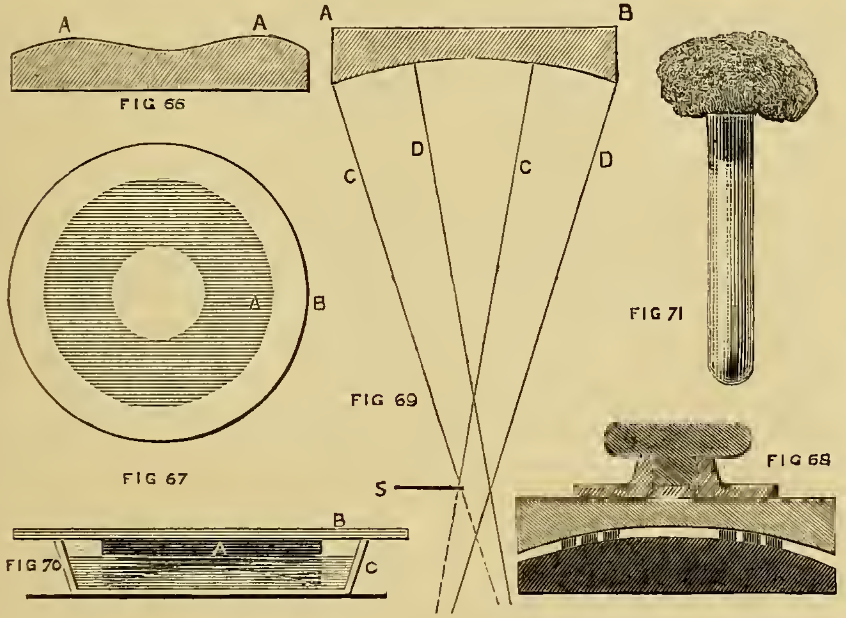


FIG. 66.—SECTION OF MIRROR POSSESSING HYPERBOLIC ERROR. FIG. 67.—CONCAVE FACE OF DITTO. FIG. 68.—SECTION OF POLISHER PREPARED TO CORRECT ERROR. FIG. 69.—DIAGRAM EXHIBITING PROOF OF TEST BY SCREEN. FIG. 70.—SPECULUM (A) SUSPENDED BY WOODEN ROD (B) IN GLASS OR GLAZED EARTHENWARE DISH (C) CONTAINING SILVERING SOLUTION. FIG. 71.—TEST TUBE WITH TUFT OF COTTON WOOL INSERTED.

We have now to consider the process of covering the polished glass surface with a microscopically fine film of chemically pure silver, which film when duly polished with a soft chamois leather will reflect for use nearly the whole of the light which falls upon it.

It has been mentioned in a previous paper that we were indebted to the inventor of the shadow test for the adaptation of this chemical silvering process to the production of silver-on-glass reflectors, and we shall not inquire farther into the history of the many processes (each a different variation of the original) that have been published since the discovery was first made by M. Liebig.

An ordinary plate-glass mirror is silvered on the back, and the film of metal (silver or mercury, as the case may be), is protected with varnish from the air. But the reflection of any object is seen through a stratum of glass. Glass specula do not permit of a similar treatment. The silver, instead of being deposited on the back, is placed upon the front surface, and the light is reflected directly from the silver surface, the glass forming simply an accurate base for the metal. Nor is this film so liable to destruction as it may at first be considered. So long as it is left untouched, being simply protected from the air by a cover when not in use, it will retain its brilliancy and perform properly in the telescope for several years.

There are, as has just been stated, several different processes. We shall consider that which is the most modern, and, moreover, that which the writer has used with perfect success. It was first given to the world several years ago by an American optician, Mr. Brasheur, and it has now almost superseded other methods.

Pure silver is used, not quicksilver, but the expense of silvering is very slight, and it shall be described so simply that no knowledge of chemistry whatever will be required to perform what would be in any case a very pleasing chemical experiment.

We will first consider the apparatus necessary, and I would have the reader remember throughout that although proper apparatus for the purpose may be purchased from any optician who sells reflecting telescopes, elaborate apparatus will not insure success, and homely substitutes which will suggest themselves to the intelligent workman may be used in place of those about to be given.

We shall require (*a*) Two glass or earthenware dishes one inch or so larger in diameter than the speculum, and at least 2½ inches in depth; (*b*) chemical scales and weights; (*c*) a five-ounce glass measure; (*d*) one or two pieces of glass rod, some cotton wool (best purchased from the chemist), and a piece of the very finest wash-leather.

Of chemicals we shall require—

Potash, pure, prepared by alcohol.	Nitrate of Silver.
Aqua Ammoniæ.	Distilled Water.
Nitric Acid.	Pure Loaf Sugar.
	Alcohol.

The nitric acid, besides being used in the preparation of the reducing solution, is essentially necessary for cleansing, for the great rule in silvering is cleanliness, and by the aid of the acid it is possible to render the speculum chemically clean.

The reducing solution will first require to be made; the older it is the better. The proportions given below are for 25 ounces (fluid); the proportion for a lesser quantity may be ascertained by a slight calculation. 840 grains loaf sugar dissolved in about 300 grains of distilled water,* 39 grains of nitric acid, 25 drachms alcohol; dissolve these, and make up to 25 ounces with distilled water. This forms the reducing solution.

For the other solutions for our 6½ inch mirror dissolve 50 grains silver nitrate (crystals) in 2 ounces of distilled water, 50 grains potash (pure by alcohol) in 2 ounces distilled water. We shall then be dealing with three solutions: (*a*) reducing solution, (*b*) silver solution, (*c*) potash solution; to these add a fourth, which is purchased from the chemist ready made, namely, (*d*) *aqua* (or liquid) *ammoniæ*. The silver and potash solutions may be made just before using. Now for the process.

We will assume that the dish to hold the main solution has been well cleansed, and is standing ready; the mirror only remains to be prepared. We require to suspend it face downwards in the dish provided, in such a manner that its concave surface shall be about 1 inch from the bottom of the dish. To do this a wooden lath about 2 inches by 1 inch, should be cut of such a length that when rested across the diameter of the silvering dish it will project a few inches each side, as in Fig. 70, where *a* is the lath, *b* the speculum, and *c* the silvering dish. The lath should then be carefully cemented with pitch to the back of the speculum, as in the figure.

Now procure a test-tube, and with cotton wool make a kind of rough pad, as in Fig. 71, or the tube may be dispensed with, and the pad formed in some other convenient way. Lay the mirror face upwards upon the table, and pour into the concavity a small quantity of nitric acid. With the pad (beware of permitting the acid to touch the skin) wash the speculum, front and sides, with the acid, and rinse well under an ordinary tap, finishing with distilled water. Take one of the clean silvering dishes, and suspending the speculum over it, as in Fig. 70, pour in sufficient distilled water to immerse the mirror to the depth of about ½ inch. Move the mirror to and fro slightly in the clean water, and then raise it for a moment and examine the surface. If the glass is entirely covered with a film of water, it is chemically clean, and may be replaced until required; but if, on the contrary, the water film in some places refuses to adhere to the glass, it is evident that the cleansing process must be repeated. If the glass is greasy it may be necessary to wash it in a strong solution of potash before applying the acid.

Assuming that the cleansing has been successful we will leave the speculum suspended in the distilled water while we prepare the silvering solution.

Firstly, pour about one-tenth part of solution *b* (silver) into a small bottle; we shall require it presently. Next drop *aqua ammoniæ* into the main silver solution, until the precipitate which first forms, disappears. Then add the potash solution, when a precipitate will again be formed, and will require to be removed by a further addition of ammonia. The ammonia must be added *drop by drop*, not using one drop more than is necessary to restore transparency to the solution.

Now add the reserve silver by drops, constantly agitating the solution with a little glass rod, until the whole assumes a clear saffron tint. This tint is essential to perfect success. If by error, a little too much of the reserve silver has been added, the solution will become slightly turbid, and it may then be filtered through a glass funnel in which a little cotton wool has been inserted, or the sediment which has caused the turbidity may be allowed to settle, and the clear liquid drawn off for use.

The solution may now be poured into the empty (or second) silvering dish, and distilled water added to make up a sufficient quantity of solution to permit the speculum to be immersed, as in the other vessel, to the depth of about ½ inch, leaving at least 1 inch in depth of solution between the polished glass concave and the bottom of the dish.

* Distilled water can, in town, be obtained from the chemists at a nominal price. In the country pure (filtered) rain water may be used.

Add now four drachms (fluid) of the reducing solution, and thoroughly stir the whole with a glass rod. The solution will very shortly begin to turn to a pinkish colour ; when the mirror may be lifted from its temporary immersion in the distilled water, and be quietly inserted in the prepared solution. It should be lowered in a slanting position so as to prevent the formation of air bubbles. If the mirror is found to be immersed too far, it may be raised by slipping wedges between the projecting ends of the wooden support and the sides of the dish.

The solution will continue to *darken* from pink to brown, from brown to black. A heavy film of silver will be thrown to the surface, being at the same time deposited upon the glass. Finally, in a space of time varying from a few minutes to half an hour, according to conditions of temperature (the silvering is best performed in summer) and of solution, the fluid will again change colour to a turbid brown, as may be seen if the silver film be moved with the glass rod. The speculum must then be removed, and well swilled with ordinary water, and finally with clean distilled water, when it may be set on edge in a safe place to dry, the water draining off on to a pad of blotting-paper. The silver surface should not be tampered with until it is thoroughly dried, when the wooden support may be knocked away from the back of the mirror.

Two rubbers of finest chamois leather padded with cotton wool should now be prepared from pieces of leather about 4 inches square. The cotton wool should be laid in the centre of the square, and the edges of the leather gathered up and tied round, forming a kind of cotton wool dumpling. One of the rubbers will be used without any polishing powder, for the other a small quantity of rouge should be prepared by levigation between two sheets of glazed writing paper.*

The speculum, having dried, may be placed upon a flat table, and any dust which may have accumulated, lightly brushed off with a tuft of new cotton wool. The plain rubber should then be moved in an endless stroke of tiny spirals over the whole surface, making the wear as equal as possible. This is done to consolidate the silver film. The other rubber should then be slightly touched with the prepared rouge, and used in a similar manner to polish the silver surface, which should receive in ten or fifteen minutes a beautiful black polish. The mirror is then absolutely completed, and in that state, but screened from dust and damp, we must leave it while we arrange in our next paper, the smaller flat speculum, and a rough and ready mounting for both.

A friend of the writer (before mentioned) has found that a hard brilliant film is obtained by dividing into two equal parts the solutions just given, and really silvering the mirror twice, one coating immediately over the other.

The process, save that all solutions are divided, is identical with that just described, but when the mirror is moved from the first dish of distilled water in the silvering solution, a second silvering solution is prepared in the former dish, the distilled water being reserved in another vessel for rinsing purposes. When the first solution has turned black, and the silver has been deposited, the reducing fluid is added to the second silver solution, and the mirror inserted in the newly prepared bath, where it receives its. second coat. By this modification it is found that thirty grains of silver will deposit an excellent film on a $6\frac{1}{2}$ inch mirror, thus allowing the experimenter to economise in the most expensive item, the nitrate of silver. While in the first bath the silvering dish is itself coated wherever the solution reaches with a thick coating of silver, in the second bath the silver seems to deposit almost entirely on the already silvered speculum.

To command success, in addition to the cleanliness, which, it has been before remarked, *must* be observed, it is advisable to keep the mirror, the silvering dishes, and the chemicals together with any water it is intended to use, in the same apartment for at least twenty-four hours before silvering. If the mirror and the solutions are of unequal temperature there is great risk of entire failure.

It will be found that the silver film, although apparently opaque, is in reality slightly transparent. The thickness of the metal has been calculated by Dr. Draper to be about one two hundred thousandth part of an inch. The question of the preservation of this beautiful surface must be left to be considered in another place.

Such a thickness as the one two hundred thousandth part of an inch is so slight as to be inappreciable by our minds and senses of perfection, which are accustomed to deal with thicknesses of far greater magnitude, and are accustomed to consider the sheet of paper on which this is printed as being extremely thin. Yet two hundred thousand of these sheets placed one on the other would together constitute a thickness of several yards ; I do not attempt to calculate how many. Readers who are curious in the matter may be left to do this for themselves ; I only wish to call attention to the almost infinitesimal thinness of the deposit.

(*To be continued.*)

* In practice, the finest rouge for this purpose may be obtained by wiping it from the centre of the mirror with the leather pad when the final polishing is interrupted for testing ; but care should be taken not to take the rouge from near the edge for fear of taking grit at the same time.

MAP COLOURING, MOUNTING, ETC.

By JOHN BRION, Constructor of Relievo Maps to His late Royal Highness the Prince Consort, Author of the "Construction of Relievo Maps," the "Renovation of Paintings," etc.

II.—WALL AND LIBRARY MAPS—CHARTS AND GLOBES—MAPS OF ESTATES AND GROUND PLANS OF BUILDINGS—STENCIL COLOURING.

EDUCATIONAL wall maps and library maps differ much in size; the smallest may be stated at about 3 feet by 2 feet, the largest at 7 feet by 5 feet, but whatever be their size, they are usually printed and coloured in two, four, and more divisions, which are joined together, when mounted, so as to present an entire sheet. The differences between colouring these maps and the "atlas work," mentioned in our former article, are many, but of a simple character, and may be briefly particularised.

Let Fig. 1 represent a school or library map of England and Wales, size 5 feet by 3 feet 6 inches, divided into four parts, A, B, C, D. This would be called a four sheet map, and we should proceed to work on it thus. Assume that we have half-a-dozen to colour: Take the six sheets, A, and pile them at your left hand, as described in our former article, do the same with sheets B, C, D, making four little piles. Be careful to keep the sheets in their respective divisions throughout your working, it will save you much time and many perplexities. Damp the faces of the sheets A, B, C, D, with gall and water, as directed in our previous article, and prepare for "coasting" the whole. Here some attention will be needed to secure uniformity in depth of colour through all the maps. To obtain this necessary point, take care—First, to mix sufficient colour to coast the twenty-four sheets; and, secondly, keep your colour frequently stirred while you are using it, also test it now and then on a piece of blank paper to see that it does not vary in tint from a first pattern line, which you ought to draw before beginning your maps. If, in the course of working, you find your colour has become deeper, add a little water to lighten it; if it has grown paler, deepen it by the addition of sufficient colour from your cake or pan. You will require a tea-saucer wherein to mix the Prussian blue for this large work, as the small saucers will not hold enough.

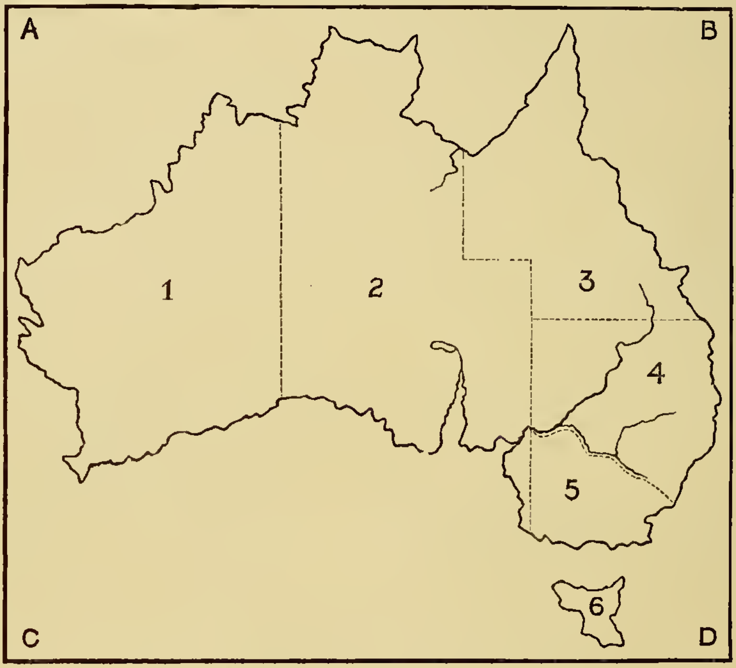


FIG. 5.—SKETCH MAP OF AUSTRALIA AND TASMANIA.

Begin with sheet A, as it is the easiest of the set, and the practice upon it will give you facility and confidence for the others. Commence north, at Berwick, and come south to the edge of your sheet, at 1, Fig. 3, making your blue line about three-eighths of an inch in width, using pencil No. 3, *vide* our previous article. Soften off with water and brush No. 5, quickly, as in "Atlas work." If you cannot draw your coloured coast line with moderate rapidity, so as to leave the beginning of it wet at the time you have reached the end, take half the distance and soften off, then finish the remainder of the blue line, taking care to make a perfect union of colour at the point of recommencement. Having completed sheets A, proceed in like manner with sheets B, C, D. You will do well, while working, to place two or more sheets, say A, B, or C, D, upon your bench or floor, and see whether your coast lines at the junctions, 1, 2, and 3, Fig. 3, perfectly match each other in width of line and depth of colour; this should also be done when you are working upon the county divisions.

The coast lines being finished, we may proceed to the outlining of the counties. The instructions given in our previous article, respecting Palestine, will apply here, excepting that the outline should be increased to about this width :

The following list of colours for England and

Wales will guide the reader in working on the whole of the divisions :—

Yellow.—Nottingham, Salop, Warwick, Bedford, Wilts, Durham, Essex, Sussex, Monmouth, Cardigan, Carnarvon.

Lake or Carmine.—Northumberland, Leicester, Huntingdon, Bucks, Brecknock, Suffolk, Kent, Hants, Isle of Wight, Gloucester, Devon, Pembroke, Merioneth, Lancashire.

Grey or Cobalt Blue.—Derby, Rutland, Surrey, Cambridge, Flint, Westmoreland.

Green. -- Stafford, Radnor, Hertford, Northampton, Yorkshire, Norfolk, Dorset, Cornwall, Glamorgan, Denbigh, Isle of Man.

Burnt Sienna.—Montgomery, Lincoln, Middlesex, Oxford, Somerset, Hereford, Carmarthen, Anglesea, Cumberland.

Roman Ochre.—Cheshire.

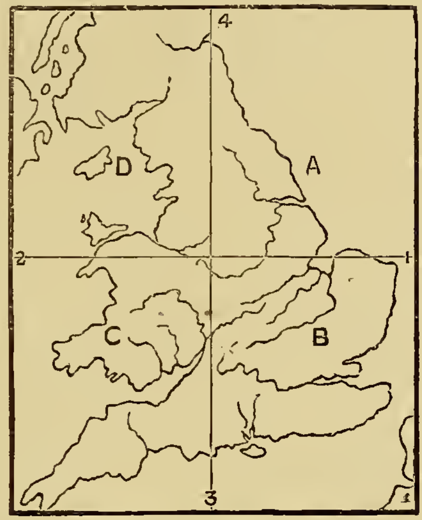


FIG. 3.—SKETCH MAP OF ENGLAND AND WALES.

A broad, softened line of carmine between England and Wales, and between England and Scotland, with the part of France in pale sienna, part of Ireland in pale green, and the part of Scotland in pale Roman ochre, will complete the outlines. Much of the sameness and patchwork-like effects of maps can be avoided by using various tones of the same colours, as gamboge, Naples yellow, orange yellow, instead of keeping to one kind of yellow.

The "flatting in" of large maps differs in no way from that of "Atlas work," *vide* our previous article. School maps require a bolder style of colouring than library maps; the latter, while they cannot be too clear, demand finer and more delicate treatment, which experience and care will soon enable the reader to attain to.

The advice given in Part 20, page 413, Vol. II., AMATEUR WORK, under the head of "Relievo Maps," applies so exactly to what I would say here, that I trust the reader will pardon me for repeating myself in a short paragraph.

"No attempt must be made to colour an adjacent county until the one previously tinted is perfectly dry, or the result will be a blurred boundary line. It must also be stated that very pale or very strong colours should alike be avoided. Whatever variation you make in the foregoing table of colours, it will be all important to strive to make your tints harmonise. Greens and blues should not be in juxtaposition, but broken by the warm tones of lake and sienna, etc. After a little practice the colourist will be able to arrange his own palette independently, when he will find that almost as great a variety of effects can be produced upon a map as upon a picture."

In Mariners' Charts, the whole of the sea is usually coloured with a light blue wash, which, in large work, may be very effectively laid on with a piece of fine sponge instead of a flatting-in brush ; the indentations of the coast will however require the use of a pencil, say No. 2 or 3. The blue wash must be sufficiently pale to admit of the soundings, reefs, sandbanks, etc., to be read off with the utmost facility. The shore-line is generally marked with a fairly broad line in some colour that contrasts well with the sea, as umber, sienna, sepia ; lighthouses are indicated by a strong spot of carmine or lake, with a touch of yellow by the side of it.

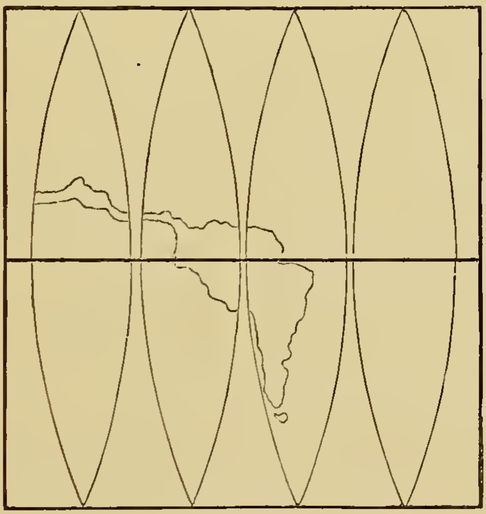


FIG. 4.—GORES, OR MAPS FOR COVERING GLOBES.

The Colouring of Globes requires great care and good previous experience on "flat work." Much really artistic ability, both in engraving and colouring, is engaged in this department of cartography, as may be seen by even a cursory examination of the globes of our chief London makers. The maps are usually mounted upon the globes before they are coloured, or, in technical language, the globes are "*covered*" before they are handed over to the colourist. The maps are termed "*gores*," and as will be seen, *vide* Fig. 4, differ entirely in shape from ordinary sheet maps, being in reality, sections of the surface of a sphere.

These sections are mounted upon the globes so

neatly, every piece being fitted to an engraved line of longitude, that when they come into the hands of the colourist it is difficult to discover where they have been united, and thus they present a clean faultless sphere. Remembering that the surface whereon you now have to work is a curved one, and not a horizontal plane, and, therefore, one requiring greater care to prevent the colours from "running," your methods of proceeding need not differ in any important particular from those already given. But instead of merely lining the coasts, it is customary to colour the sea in full, as we have described under the head of *Mariners' Charts*. An excellent effect is often produced by making the wash of a sea green, instead of a blue colour, which may be readily done by mixing a little green with your Prussian blue. The colours of the land are as various as are the globes of different makers, but in nearly all you will find the principles enunciated in Chapter I. Celestial globes are generally washed in a uniform blue tint, with the zodiac warmed into a pearly grey by a touch of lake in the colour; the asterisms should be very slightly toned with sepia and lake worked into a delicate neutral tint. The wooden horizon of a globe has three concentric circles—the inner is marked with degrees of the compass; the exterior contains a calendar; the middle forms a broad band, whereon are depicted the signs of the zodiac. Colour the inner and outer bands in delicate lake, the zodiac in a pearly blue tone, corresponding with the zodiac of the globe, the asterisms to be "picked out" with the warm neutral tint we have just mentioned.

To those of our readers who wish to practise this art we recommend the purchase of an old and valueless pair of globes, which can often be picked up at the depositories of "odds and ends" for a mere trifle. Suppose you follow our advice and secure the "jetsam," cut "gores" in fine white demy paper, according to Fig. 4, taking care to follow exactly the measurements of the degrees of longitude marked upon your globes; in plainer terms, make your "gores" exactly of the same size as those upon the globe. When ready, damp these moderately on both sides and let them lie a while to "mellow" Prepare white paste by mixing a teacupful of cornflour and a teaspoonful of ground alum with sufficient cold water to form a thin cream, boil in a clean saucepan over a slow fire for ten minutes, keeping the paste constantly stirred. When cold, use this to mount the gores upon your globes. On them, when quite dry, sketch in pencil simple outlines of the earth and a few of the asterisms, upon which you may practise the methods of colouring we have described. If you cannot procure the old globes we have suggested, purchase a child's large india-rubber ball, run a long knitting-needle through it to form an axis, the poles of which will enable you to hold it easily; cover this with paper, and though small, it will allow you to practise all we have spoken of. We recommend all who are really desirous of acquiring this art to carefully examine the modern globes exhibited in the windows or show-rooms of map-publishers. No two makers quite agree in style, but the principles we have endeavoured to explain will be found in all, and the judicious observer can "read, mark, and learn," to his own advantage.

Maps of Estates and Ground Plans of Buildings, if printed, will be coloured by the methods recommended for sheet maps, but if they be the original work of the draughtsman we must proceed somewhat differently. Mount the drawings before colouring by the instructions which we shall presently give. When dry, if the map has been drawn in Indian ink, you may follow the directions which we have given for printed sheet maps, as there will be no danger of the work being blurred by the water colours if you use them as sparingly as is consistent with the obtaining of sharp outlines and even washes. On no account allow your colours to settle in pools in any part. None but inexperienced draughtsmen will use ordinary writing-ink in making a plan or map that is intended to be coloured, for the merest tyro must know that lines drawn therewith will "run," *i.e.*, blurr, when touched with water. But on rare occasions you may have to deal with such matters, then mount as directed. When the drawing is dry give the whole of the map as light a coat as possible, with thin, warm, parchment size, using a brush of the same form as your flatting-in brush, but an inch wider. Be especially careful to lay on your size quickly, omit no part, and do not go over the same place twice. Dry speedily in a warm room or expose the map for a few minutes to the sunbeams. When quite dry you may work in safety, using a little oxgall in your colour if there be any difficulty in working it upon the sized surface.

In Ground-plans of Buildings it is customary to colour brick erections in a wash of light red, stone edifices in Naples yellow, roads and pathways in Roman ochre, lawns in emerald green, gardens in olive green.

In Maps of Estates, buildings may be coloured in carmine or lake, parks in Hooker's green, woodland in burnt umber, or sepia warmed with lake, arable in Roman ochre, pastures in olive green, roads in brown pink, lakes, ponds, and rivers in softened lines of Prussian blue. When estates are divided into farms, each holding should be enclosed with a broad, distinct softened line. When maps are to be full coloured, a very pleasing effect can be produced by outlining each field or other division with a line softened from the

boundary towards the centre of the space enclosed, and there mingling the wash with the edge of the softened line so that both shall be perfectly blended. Maps are occasionally drawn on vellum and parchment, and, when well done, they look very beautiful; they are coloured in the same manner as those upon paper, a little of ox-gall only being required to make the colours work freely on the occasionally greasy surfaces of the skins.

Stencil Colouring is but little practised in England. In the United States it is extensively employed. Its effect, except in rare cases, is not so good as that of pencil work, but it has the advantages of requiring less skill and being more rapidly executed; it is, nevertheless, seldom resorted to excepting when very large numbers of maps are required. Plates are indispensable in this kind of work, and may be prepared thus: Take one of the maps which you intend to colour, cover it with a piece of tracing cloth, and secure both to a drawing-board or other smooth surface. With a fine pen and ink trace the coast-line and boundaries as marked on Fig. 3.

Provide yourself with brass-foil of about double the substance of the paper on which this magazine is printed. Cut from it three sheets of the size of the space bounded by the margin of your map, A, B, C, D. Wash one side of the plates with strong vinegar, and on them mount, with good solution of gum arabic, a damp sheet of thin white demy paper. Let these get thoroughly dry. Meantime, prepare transfer-paper by taking a dry sheet of your demy and blacking it on one side with dry powdered blacklead or lamp-black. Rub either of these well into the paper with a little ball made of soft white rag. Clear off the superfluous black, and repeat your rubbing till the blackened sheet does not transfer to clean paper without pressure from a tracing tool. When all is ready, lay the black side of the transfer paper upon the papered side of one of the brass-foil plates. Put your tracing upon the white side of the transfer-paper, which is now uppermost, and secure all from slipping by placing heavy weights at the edges, or by some other means. With a tracing tool, and moderate pressure, go over the coast-line and divisions of sections 1, 3, and 5. Remove the tracing and transfer-paper, and you will find a faithful copy of the divisions, which you have gone over, upon the white paper affixed to the brass-foil. In like manner trace the coast-line and divisions 4 and 6 upon the second plate; and, lastly, upon plate three, trace the division 2. With a pair of small sharp scissors cut from the brass-foil the spaces 1, 3, 5, 4, 6, and 2. A good pair of scissors will cut the brass-foil to the most intricate tracing almost as easily as thin card-board. Stencil sheets can be made of waterproof paper, but they do not last long, nor is the work done by them nearly so good as from foil. An excellent tracing-tool can be made by grinding or filing down a knitting needle, or the steel end of a lady's crochet needle, so as to form a fine slightly blunted point that will run smoothly upon paper. After cutting your stencils, remove the paper from them by hot water, lay them upon the back of a plate, and with the handle of a metal spoon, or other suitable article, rub down the edges of your coast-lines and divisions in order to get rid of any raggedness that may remain, and which would, in various ways, deface the colouring.

Half-a-dozen or more of stencil brushes will be required. These are a little like a shaving-brush with the hair cut down to form about an inch and a half stump; they may be had at from 2d. to 6d. each. The colours may be the same as those recommended for pencil work, but require a little different mode of preparation. This consists in soaking a sufficient portion of a cake in just sufficient water to cover it; when reduced to a paste, add water and a very little ox-gall, till you obtain the tone you desire. Charge your stencil-brush with the colour you intend to use; rub your brush well upon the sides of your saucer till the colour is worked into the brush, and is not too full to run. Try it upon a piece of blank paper, keeping the handle of the brush pointing to the ceiling, and strike with the face of the brush, as is done with a stamp in marking post letters. If it makes a pool of colour rub some out against the side of your saucer; if the brush does not "deliver" the colour properly, work it well upon paper and supply more colour till you obtain freedom and certainty. Lay the map which you intend to colour upon a mill-board, previously covered with a piece of calico. Place stencil plate No. 1 upon the map, and "register," *i.e.*, "fit" it exactly to the outline of the coast. Put a weight upon it, or hold it firmly down with your left hand, while with your right you stencil division 1 in lake; then take a second brush, previously charged with yellow, and with it stencil division 3; division 5 can be done in Roman ochre. Supposing you have a number of maps to do, stencil in all with the before-named colours, then take up the second plate, and with it colour division 4 in sienna, and division 6 in emerald green. With the third plate, division 2 can be coloured in with Hooker's green, which will complete the map.

Be very careful to let the motion of your stencil-brush be perpendicular, otherwise the hair will get under the edges of the plate, and thus spoil the map. It requires considerable practice to become an adept in this kind of work, but not so much as in pencil colouring.

Though stencil work is seldom so delicately and effectively executed as pencil work, some very beautiful examples may be found upon the Geological Ordnance Survey Maps, and especially on those of Cornwall and Devon. I know of nothing in map colouring that excels them either in richness of colour or evenness of work.

Colouring by lithography, mounting, varnishing, and fitting will form a concluding article.

(*To be continued.*)

DRY-PLATE PHOTOGRAPHY:

THE GELATINO-BROMIDE PROCESS.

By C. C. VEVERS.

VII.—PORTRAITURE.

HOW many of my readers have followed the advice I gave in Chapter IV., and steered clear of portraiture until, at least, they had learnt how to manipulate the camera with some degree of success? Not many, I am afraid. Portraiture seems to have the power of fascination which no beginner can resist. Each of the photographer's sisters, cousins, lady friends, wife or sweetheart (as the case may be) are victimized, and their images secured with varied success; at first, little persuasion is required, and the operation of posing—blinking at a certain object for several seconds, with features immovable, is voted "grand fun;" but, eventually, "the man with the camera" is pronounced by one and all to be "an awful bore" and an "immoderate nuisance." Yet why should this be the case? Portraiture is hardly more difficult than instantaneous photography; still this fact remains, in portraiture the uninitiated does *not* flourish. The cause of failure, I think, is that unless the amateur goes to considerable trouble in fitting up reflectors, etc., his results do not equal the professional's work, who has a studio specially built for portraiture. If, however, the amateur would spend a little more time in getting ready for his sitter (I may here remark, in portraiture the subject is always spoken of as the "sitter," whether he be taken standing, sitting, or lying), he would have no difficulty in producing as good photographs as the professional. In speaking thus I allude to *single* portraits, more especially to "head and bust photographs;" for groups and the like no preparations are necessary—indeed, the amateur has the pull of the professional, as he generally has the most attractive, natural, and, consequently, suitable surroundings in which to pose his sitters, for with small figures, reflectors, etc., are not necessary, and groups being taken out-of-doors a much shorter exposure is required than when taken in a studio; and the amateur will understand that in photographing living objects rapidity of exposure is a matter of no little importance.

We will first deal with groups, these being subjects for which the least preparation is needed, and being generally the easiest to photograph. The greatest difficulty when taking a group of several persons is to retain a natural pose or position. Many photographers, both professional and amateur, persist in forming a row of their subjects standing behind another row sitting, and in front yet another line squatting on their haunches. Some writers advise the photographer to allow the subjects to pose themselves, and take them "just as they stand;" but, unfortunately, this plan rarely succeeds in forming a suitable group: they must be posed, but posed artistically.

The first question to be asked is, what is the picture to be composed of? A family group? Then, by all means, let the picture be taken near the house or in the grounds—in some nook that will be easily recognized in the picture, and by familiar surroundings show that the picture represents a *home* group. If possible, have a dark background of foliage, so as to throw the principal objects into relief; several rustic and garden chairs will be required, and, if there are children, a few toys strewn about the ground will tend to make the picture look more natural.

Now as to posing. The elderly people should be seated, while the younger children, who often cause a great amount of trouble, may be playing on the ground. Endeavour to form a kind of pyramid of the group by placing the tallest or highest figure in the centre, while a small child, dog, or toy, may be placed at the sides to preserve balance; by bringing the outside figures a *little* nearer the camera than the centre figures, in the form of a semicircle, the whole of the group will be brought equally into focus, this remark applies more to portrait than to landscape lenses, so as to propitiate with spherical aberration. Having grouped your subjects, before posing them in the strictest sense, obtain the focus and get the dark slide ready, so as not to keep your sitters staring for several minutes, previous to exposure, at some object, and endeavouring to keep still when it is not absolutely necessary that they should do so. Do not make the group fill the whole of the ground glass, as, if the surroundings be attractive, a prettier picture may be obtained by including objects several yards above, and at each side of the group itself.

The focus obtained, lens capped, the slide substituted for the ground glass, and covered with the focussing cloth, and the shutter withdrawn, then you may pose your sitters; not more than two or three

persons at most should be allowed to look towards the camera, as nothing denotes "being taken" more than all the sitters staring at one object. The amateur, however, is often puzzled to find something for one and all to look at; let each figure have some natural occupation, let none be gazing unmeaningly into space, but always include in the group the object

"patchy" appearance, so that, if there be any sun, it is advisable to wait until it goes behind a cloud, unless, of course, the group is in the shade. All is now ready. To keep the youngsters quiet say, "Keep perfectly still until I have counted four. Now, steady;" count the seconds audibly, "one, two, three, four; that will do;" and feel happy if all have kept still.

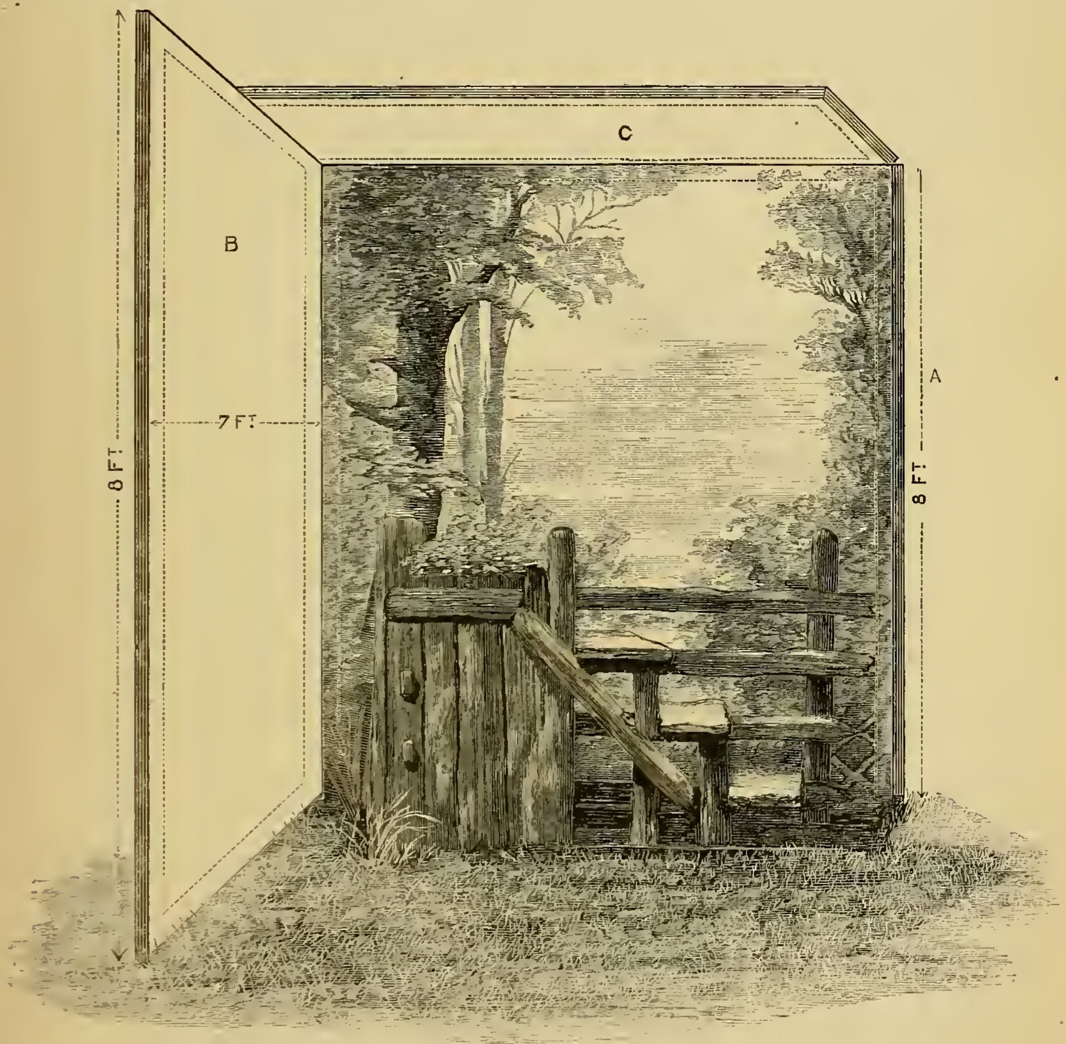


FIG. 33.—SKETCH SHOWING SCREEN WITH BACKGROUND, STILE, ETC., FOR SINGLE FIGURES.

each one is looking at; in our ideal group the father may be reading a paper, mother petting or nursing the youngest, and children playing about on the grass.

Now, as to exposure. Unless the light is very rapid, or the younger members of the party unusually quiet, it is best to use a large stop; the length of exposure my readers ought by this time to have no difficulty in judging, but four or five seconds may be taken as the average. Sunlight give the faces a

Sporting groups, such as cricket, tennis, archery, football, should be taken with appropriate accessories and surroundings. Here the rule just laid down, not to group your subjects like so many waxworks or Christy Minstrels, may be applied with more force than in the former case; nothing looks worse than a series of rows of men, one behind the other, all in similar uniforms or costumes. Such pictures should not be taken so much for the likeness of the subjects

as for a pretty and effective group. If likenesses are required then, say I, take a head and bust of each separately. One may often see in shop windows a photograph of the Australian team, or the latest University teams grouped—no, not grouped—formed as I have just described; how much more artistic and lifelike would these pictures be if a head of each were taken, the whole carefully "vignetted" on to one sheet of paper, copied, and reduced, if necessary, in the camera, and printed in this form? But I am wandering, and am describing an operation which some of my readers will hardly understand.

Revenons à nos Moutons. A cricketing group should be formed round the wicket if possible, for to photograph the cricketers as at play would reduce the figures too much, and leave the picture full of blank places. First select a good background, *then* pitch the wickets—it matters little if the ground selected be not like a billiard cloth, as if not suitable for playing cricket upon, this little defect will hardly be observable in the photograph. Always pose such groups as these illustrative of some part of the game, do not form a meaningless group, but as though they had thus been brought together for some object. Thus, in our imaginary group, the cricketers are waiting round the wickets until "the next man in," who is stood near the wicket drawing on his gloves, is ready for play; we have another man standing near by resting on his bat and conversing with a man who is evidently the bowler, the wicket-keeper adjusting his leg-guards, etc.; a carpet bag, bat, ball, etc., will form useful accessories, and help to make the picture more real.

I think the amateur will, by this time, see that the great difficulty in taking a group of several persons is to retain a natural and easy position, and make them appear as if they were brought together for some purpose, and were totally unaware that such a thing as camera and lens were in existence.

We now turn our attention to single figures. I shall deal first with full length and three-quarter photographs. I am well aware a studio is quite beyond the reach of most amateurs, but a background or two, head-rest, and one or two other almost necessary accessories can now be obtained for very little money; in fact, the amateur could make everything, with the exception of the head-rest, himself. I cannot describe the process of painting photographic backgrounds in these papers; but either Mr. Benwell or myself will do so at some future time: the work, however, is very simple, the main difficulty that will present itself to the amateur will be to obtain sufficient softness, or "out-of-focus" appearance of the subject forming the background, in exterior backgrounds especially, so as not to attract the eye from the principal object. A background for single figures should measure *not less* than 8 or 9 feet high by 6 feet wide; it should be simply painted in grey distemper on best flax canvas, which costs about 1s. 3d. per yard run, 72 inches wide. If portraiture is to be extensively practised, two backgrounds, interior and exterior, will be a necessity. The artistic taste of photographers, although far from faultless, has, during the last ten years advanced almost more rapidly than has the photographic profession itself; and now one hardly ever sees such frightful daubs, devoid of all softness and perspective, as figured in every photographic "gallery," and were reproduced in every family album a decade ago. Most artistic backgrounds may be obtained at prices varying from 15s. to 40s.; the photographic stock-dealers are always pleased to forward photos of backgrounds they have in stock for selection.

Rustic accessories, such as a chair, stile, etc., will be required, these the amateur should be able to make himself. A stile, such as is illustrated in Fig. 33, is very easily made out of half inch stuff and afterwards painted. A head-rest is at times very useful, but far from being indispensable; and I should advise the amateur to work without its aid whenever possible, as it gives most persons a very stiff and unnatural appearance, besides making many people nervous and fidgety. "A well-posed figure may be easily upset by a bungling use of the head-rest."—H. P. ROBINSON. It is very rarely required for out-door portraiture, but whenever used the operator must see that no part of it is shown on the picture. I would recommend Emmerson's carriage head-rest, but they are almost too expensive for an amateur, the price being £3. Good ones can, however, be obtained for about £1; and simpler ones to attach to the back of the chair, from 2s. 6d. upwards.

After what I have already remarked respecting the posing of groups, I need not again go into the details of posing single figures, beyond saying that the picture should show a natural and not an affected one. Above all, do not let the sitter cling to the backs of chairs, tables, etc., as though he were afraid they were going to escape and walk out of the picture. Do not put any accessory in a position where it will attract the eye from the sitter, and do not fill the picture with unnecessary furniture; avoid all parallel lines, do not bring the sitter's hands too prominently to the fore, as this will make them look large and coarse; endeavour to hide the sitter's feet as much as possible, unless they are uncommonly small or pretty; and do not twist the subject's head off his or her shoulders to gain an "effective pose." I cannot do better than quote Robinson's "Pictorial Effect," and again ask my readers to study most thoroughly this valuable aid to the photographer: "A single figure should be complete in itself; it

should not appear as though it had been cut out of a group, and it should be incapable of having another figure added to it without injury. The head being the chief object, every line should be composed in relation to it, and the student will find the rules of pyramidal composition invaluable to him here. He must consider contrast of lines and balance, variety, repose, and, above all, unity and simplicity. . . . . The action of the figure should be that which is most common to the individual, such a position as shows it to the best advantage. No violent action should be allowed; no appearance of strain. . . . . . The student will do well to observe attitudes assumed in every-day life, and adapt them to his art."

Owing to the many figures composing a group, it is almost impossible to light the subjects with any good effect, but with single figures it is different, and the photo of a well-posed sitter can be easily spoilt by injudicious lighting. I intend to go more fully into the subject of lighting in the next article, when I shall deal with "head and bust" portraits, but will say here that the light must not come directly from the front, side, or above the sitter, but it must be carefully regulated, so that the sitter receives more or less light from each direction, and considerably more from one side than the other, so as to throw a shadow on one side of the face. I have seen very excellent pictures taken where a house has stopped the south light; another building, on which the background was hung, stopping the west light; the light then came from the north-east, but sufficient was reflected from the house to prevent the right side of the face being totally in shadow. The simplest and most effectual contrivance for the amateur is to make a frame as shown in Fig. 33, something after the manner of a clothes-horse. A is a frame on which the background is stretched, and should measure the same size as the background, say, 8 feet by 7 feet; B is another frame, about the same size as A, to which it is hinged, it should be covered with light brown paper so as to reflect the light a little but not too much; C is a smaller frame, measuring about 7 feet by 3 feet, also hinged to A, this is to stop a deal of top light, and, when in use, is held in place by resting on B. Such a frame as this can be folded up when not in use, and with careful management will produce results equal to pictures taken in the most elaborate lighted studios.

Never allow the sun to shine on a single figure, and do not attempt portraiture on a dull day, as it not only prolongs the exposure but reduces the brilliancy of the picture. For a bright summer day in good light, ordinary plates, large stop of a doublet [illegible], an exposure varying from three to nine seconds is required. Develope as usual.

(*To be continued.*)

PRACTICAL SCENE-PAINTING FOR AMATEURS.

By HENRY L. BENWELL.

XVII.—LOCAL SCENES—MOONLIGHT AND NIGHT SCENES.

IN most of the modern sensational dramas which are now produced at some of our large theatres, a local scene, representing some well-known spot is generally introduced, and is always a source of great delight to the "Pittites" and the "Gods." Messrs. Wilson Barrett and Augustus Harris are singularly successful in their choice of subjects for this class of scene, which indeed shows great taste and judgment on their part.

In choosing subjects to illustrate some specimens of night scenes, I have purposely selected two drawings which answer the double purpose of being both local scenes, and also containing moonlight effects. Fig. 84 is a drawing of a scene used in an American drama, entitled, "The Unknown," and represents New York Harbour on the left, and Brooklyn on the right, together with the Suspension Bridge, which connects the two places. When well painted, and with all the different effects properly introduced, it proves a most charming and realistic stage picture. The whole of the design shown in Fig. 84 is painted on the back cloth, the windows, lamps, moon, etc., being lit up from the back. The stage itself is covered with water rows, between which a boat and four men are worked on and off with very good effect. There is nothing new in all this, and I merely mention it as a sample of this special class of scene.

The next sketch, Fig. 85, is taken from "Hoodman Blind," produced at the Princess's Theatre, under the management of Mr. Wilson Barrett, in 1885. It depicts in a most vivid manner (I am speaking of the scene itself) a portion of the Thames Embankment by moonlight. In the foreground is Cleopatra's Needle and the Sphinxes; on the right is the Embankment, vanishing towards Charing Cross, with its rows of electric lamps; in the distance is the ever-flowing Thames, with the moon-lit ripples on the water flitting to and fro like the real thing itself; in the dim distance can be seen the railway and Westminster Bridges, with the Houses of Parliament and the Clock Tower beyond. The illustration does not show the whole of the scene as it appeared on the stage. It was a painting of Walter Hanns, and entitled, "The Silent Highway."

The street scene, Fig. 83, which appeared in the last chapter, is another example of a local subject. This is the Monument and London Bridge. It ap-

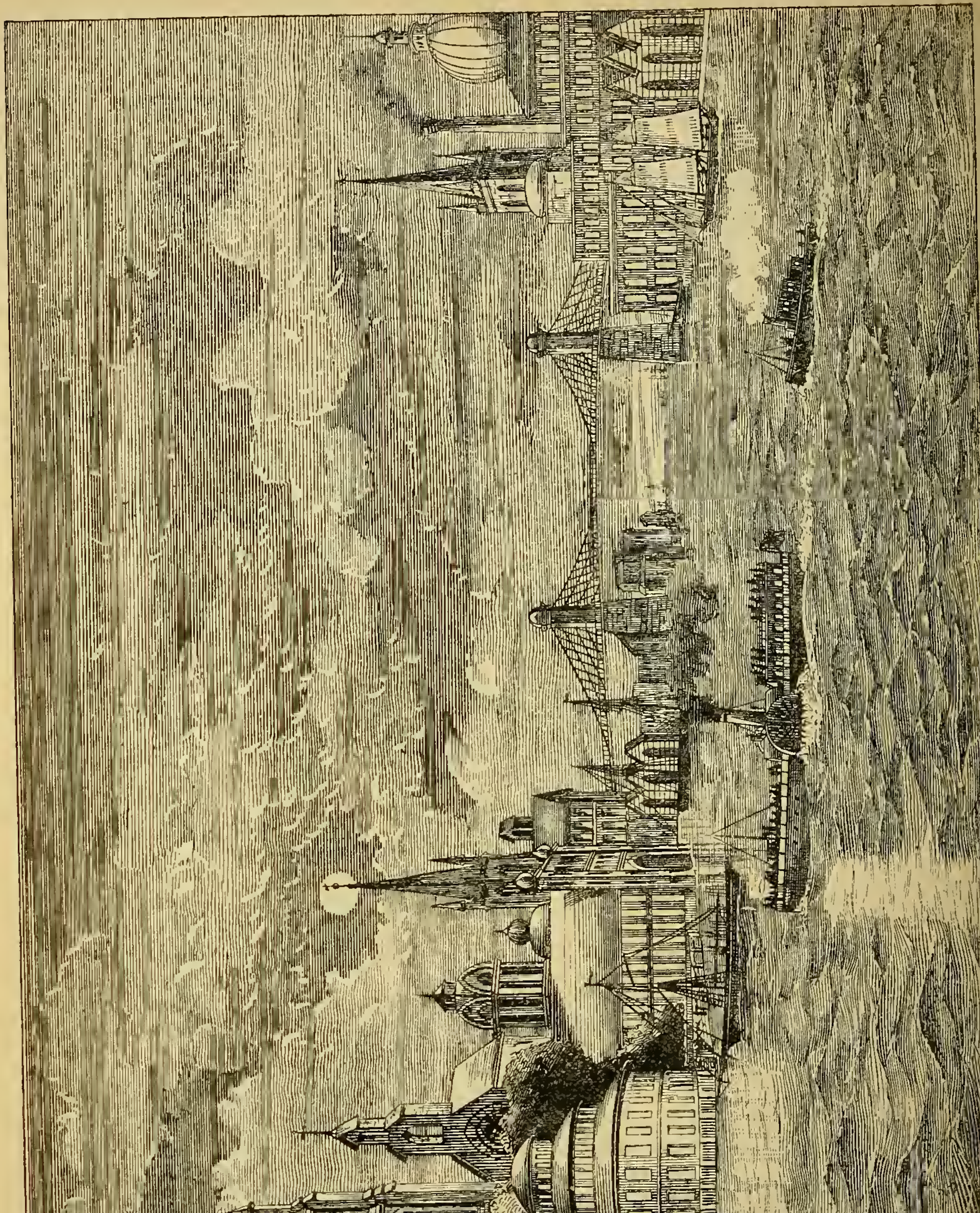


FIG. 84.—EXAMPLE OF "LOCAL" SCENE—NEW YORK: HIGH LEVEL BRIDGE BETWEEN NEW YORK AND BROOKLYN.

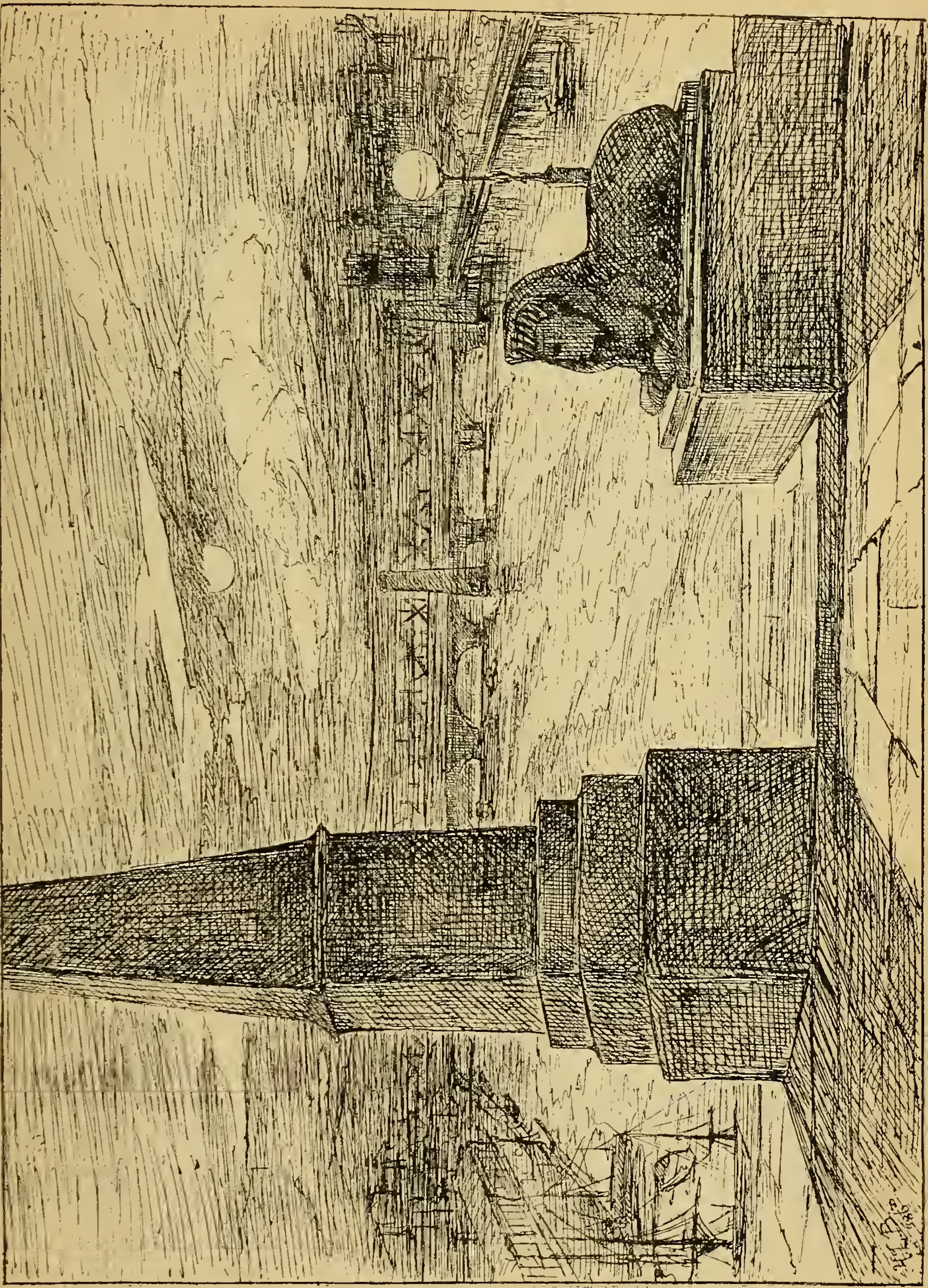


FIG. 85.—EXAMPLE OF "LOCAL" SCENE—CLEOPATRA'S NEEDLE AND SPHINXES—THAMES EMBANKMENT, FROM "HOODMAN BLIND."

pears in the drawing as an ordinary daylight scene, but if painted as a night scene, with the windows, lamps, etc., lighted, it would make a very good subject.

The specimens here given will, I think, enable the amateur to obtain some idea as to how to treat some local subject in his own district should he ever be called upon to do so.

Moonlight Scenes.—It takes but very few colours to paint night scenes, as all surrounding objects must necessarily partake of the prevailing darkness, and appear somewhat dim and hazy. Indigo will be found a most useful colour to use for this work ; also, flake white and emerald green. For lighted windows, the glare of fire, etc., the chromes and orange red will come in handy.

In painting moonlight skies the artist may use verditer and indigo ; for the clouds indigo and black, and for the lighted portions of the clouds flake white and emerald green. The buildings in the foreground may partake of a brownish hue, but all distant objects should be put in with a somewhat darker shade of the sky colour. With the above mentioned colours, the artist will be able to do most of the work required in painting cloths after Figs. 84 and 85. So it is quite unnecessary for me to dwell at any greater length on these particular subjects.

Generally speaking, night scenes are very effective, and more so when the windows of the houses, street lamps, stars, and moon are lit up from behind. This part of the work, however, comes under the head of "transparent painting," and as I shall later on devote a chapter specially to this subject, I shall delay giving the instructions as to working up these effects until the aforesaid chapter appears. I do this in order that these papers may be as complete as possible in the way of reference, and to do this each particular branch of the art must be distinctly separate, as far as it is possible to do so, and so come under its proper heading.

Another effect I shall also describe later on will be the effect of the moonbeams reflected in the moving ripples of the water, as they appeared in the "Embankment" scene, Fig. 85. Other effective night scenes are gardens, terraces, old houses, woods, with moon seen behind the trees and foliage; and, again, the sea with the moonbeams shining through rocks or caverns, such as the cave scene in "The Colleen Bawn." Examples of garden scenes have been already given with previous chapters, and it is easy to manage the colouring or lighting of these in such a manner that they may serve for day or night scenes, according to the requirements of the piece in which they are used.

(*To be continued.*)

SMITHING AND FORGING.

By GEORGE EDWINSON.

VI.—FARRIERY—MAKING AND POINTING HORSE-SHOE NAILS.

AS a knowledge of farriery is an almost indispensable part of a country smith's education, and also a desirable acquisition for amateur smiths, I will devote an entire chapter to its consideration, for, without it, this series would be incomplete. Some persons may be deterred by natural timidity from attempting the task of nailing shoes to animals' hoofs, but not a few living in out of the way parts will be glad to know how it is done ; and I hope that the following remarks will be helpful to those who may feel inclined to try their hands at "shoeing."

To the onlooker, who is not afraid of horses, the job of nailing on shoes to horses' hoofs, appears to be a comparatively easy one. The workman gives the patient and docile animal a friendly pat with his hand on the neck, passes his right hand in a gentle manner down the front of the fore leg, when the horse lifts his foot willingly, and consents to have his hoof cut and hammered according to the man's wishes. The thing appears to be simple enough as one sees the smith paring off the ragged horn and making the hoof to fit the iron shoe. How easy it appears to drive in the sharp pointed nails and ensure their points coming out of the hoof about an inch above the shoe ! Yes. It all seems easy to a strong man, but the operation is not at all a pleasant one to the poor animal should he get in the hands of an ignorant novice or an unskilled operator. It is necessary that some of the horny hoof should be pared away, the ragged and broken parts especially, to form a firm surface for the iron shoe to rest against ; but it is possible to pare away too much of the horn, and thus lame the animal. It is sometimes necessary to pare away dirty excrescences on the outer frog of the hoof, but great caution must be employed in the operation, and sound judgment must be exercised here. A badly-driven nail may cripple the poor docile creature, and a badly-made shoe may cause him hours of weary misery. As such dangers as these hang around the path of the novice in this work, I earnestly advise him to make himself thoroughly acquainted with the useful animal's hoof before he takes it in hand to cut and manipulate. To this end it will be well to carefully study the accompanying illustrations of a horse's hoof. Fig. 84 shows in section the structure of a horse's foot, and Fig. 85 presents a view of the same from the under side. Fig. 84 presents the hoof in its natural condition before it

has been shod, whilst Fig. 85 shows the bottom of a young borse's boof prepared for receiving the sboe.

On referring to Fig. 84, it will be seen that the foot of a horse is made up below the pastern bone A, of three massive bones—viz., the cornet or coronet bone, B; the navicular bone, C; and the coffin bone, D; a spongy substance named the "fatty frog," N; a horny substance beneath this named the "frog," L; and a number of tendons and masses of gristle connecting and controlling the various parts; the whole enclosed in a box of horn named "the wall of the hoof," E, in Fig. 84, and F F′, in Fig. 85, and connected to the leg by the tendons, P P′ on both sides the pastern bone, A, in Fig. 84.

In the forefoot of a horse, the toe is the thickest and strongest portion of the hoof. The tbickness of the horn gradually diminishes towards the quarters and beels, particularly on the inner side of the foot. In the hind foot, the greatest thickness of horn will be found in the quarters and heels, not at the toe, as in the fore foot. This difference in the tbickness of horn is beautifully adapted to the inequality of the weight which each has to sustain, the force with which it is applied, and the portions of the hoof upon which it falls. The toe of the fore foot has to bear the strain brought upon it by the weight of the shoulders and head (the heaviest part of the body), and a pulling strain as the animal moves forward; it is therefore made by nature of a greater substance and strength than the corresponding parts in the hind hoofs. In these, the greater strength is required in the quarters and heels, where we find the horn thicker than at the toes. In a state of nature tbe toes of the hoof are strongly developed, and are too prominent to admit of an iron shoe being fastened to them. They are also thin and pointed, and as a consequence cause the angle of the boof to be too acute. It is, therefore, necessary to pare down the superabundant horn, and level the hoof by means to be described.

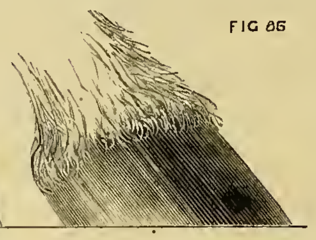
But, before we commence the paring process, let us look closely into the structure of the foot, and learn the uses of its various parts. The cornet bone, B, Fig. 84, is a massive, almost square, bone, situated partly within and partly without the foot. It receives the rounded ball of the pastern bone A in a socket on its upper surface, and fits into a socket of tbe coffin bone beneath by a rounded surface. This gives great strength and elasticity to the neck of the foot. The coffin bone, D, Fig. 84, is also a massive irregularly shaped bone, triangular in section, but of the general form of the horny hoof, into which it fits like a toe. It is of a light spongy texture, with a furrowed surface on the front and sides in the foot of a young horse. Its outer surface is covered with a vascular sensitive coat of thin plates, connected with the wall of the hoof, and named the "sensitive laminæ," shown at F, Fig. 84. This may be said to be a continuation of the coronary substance which contains the coronary glands, O, Fig. 84, employed in the secretion of new horn to the wall of the hoof. Beneath the coffin bone is another sensitive layer of blood vessels and nerves named the "sensitive sole," H, Fig. 84. It is about one-eighth of an inch in thickness, and is one of the most tender and sensitive parts in the animal's body.

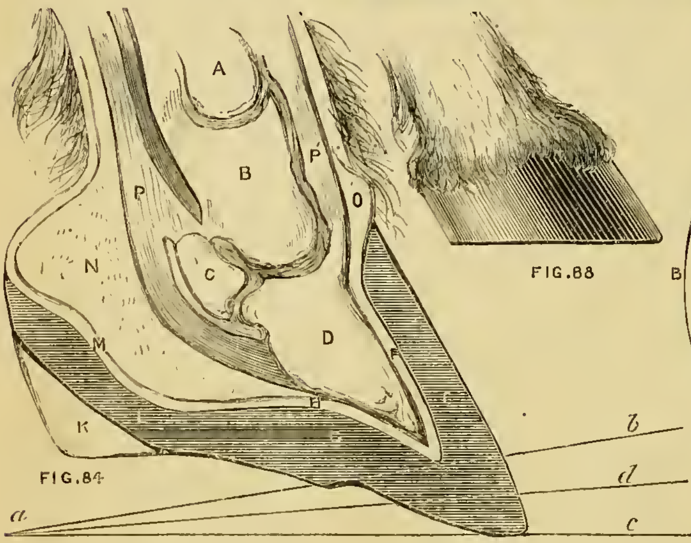
The navicular bone, C, Fig. 84, is a small but most important bone situated in the centre of the foot, close behind the upper part of the coffin bone and the lower part of the cornet bone. It has the upper and under surface and part of one of the sides overlaid with a thin coating of gristle; and is held in position by a strong tendon, P, passing down behind and under to the coffin bone. This forms the navicular joint, and upon its health and condition mainly depend the usefulness of the horse to man. It is so placed in the foot as to be continually in danger of injury, being situated across the hoof behind the coffin bone, and immediately under the cornet bone, and therefore compelled to receive the whole of the weight of the horse each time the opposite foot is raised from the ground. As it is covered with a delicate secreting membrane, liable on the slightest injury to be inflamed and thus cause lameness, it is most important that undue strain on this part should be provided against in shoeing a horse. Nature has made provision for its protection in forming an elastic cushion beneath it, named the "fatty frog," E E, Fig. 84. This elastic cushion is a spongy substance supported on a spring of horn beneath, named the "frog," N, and enclosed in a sensitive membrane named the "sensitive frog," M, the whole forming the heel of a horse's foot. The horny frog, F, is composed of wavy elastic fibres, designed to act as an elastic pad to lessen the shocks of concussion on the bones of the foot. This pad is frequently renewed with living fibres from the interior, and it exfoliates the older and harder fibre as it grows. The horny sole, G, partakes somewhat of the characteristics of the horny frog together with those of the wall of the hoof. In structure it is fibrous like the wall, but it has a tendency to flake off the old fibres in a similar manner to that of the frog. It is thickest near the wall, and it thins off at the centre of the hoof where it presents a concave form.

Let us now turn up the foot as shown in Fig. 85, and note the conformation of its under side by the aid of the sketch, Fig. 84. In a young unshod horse we shall find the lower outside edge of the hoof composed of thin ragged horn, and on looking across this we shall note that it presents the acute angle shown

in Figs. 84 and 86. The superabundant ragged horn must be pared down until the angle of the hoof has been reduced to that shown at Fig. 88. Then the under side of the edges of the wall will be seen to be level, as shown at C, Fig. 85, or should be levelled as shown there.

This is mapped out into the following parts : A, the toe; A′, the outer toe; A″, inner toe; B, outer quarter; C, inner quarter ; D, heel ; D′, outer heel ; D″, inner heel ; E E′ are the bulbs at the back of the heel. From the heels inward, toward the centre of the foot, run a continuation of the wall, enclosing a triangular space





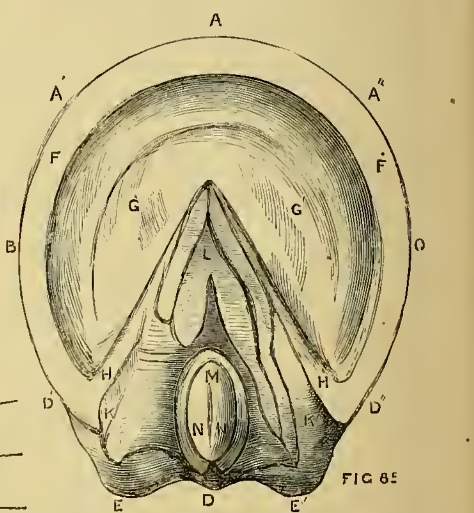


FIG. 84.—HOOF OF HORSE IN SECTION, SHOWING PARTS AND CONSTRUCTION.—A, Lower Extremity of Pastern Bone ; B, Cornet Bone ; C, Navicular Bone ; D, Coffin Bone ; E, Wall of Hoof ; F, Sensitive Laminæ ; G, Sole of Hoof ; H, Sensitive Sole ; K, Cleft of Frog ; L, Frog ; M, Sensitive Frog ; N, Fatty Frog ; O, Coronary Glands ; P, P′, Tendons ; *a b*, Line of Paring Hoof too Obtuse ; *a c*, Line of Paring Hoof, too Acute ; *a d*, Right Line for Paring Hoof. FIG. 85.—BOTTOM OF RIGHT FORE FOOT OF YOUNG HORSE.—A, Toe ; A′, Outer Toe ; A″, Inner Toe ; B, Outer Quarter ; C, Inner Quarter ; D, Heel ; D′, Outer Heel ; D″, Inner Heel ; E, E′, Bulbs of Heel ; F, F′, Wall of Hoof ; G, G′, Sole of Hoof ; H, H′, Bars ; K, K′, Commissures ; L, Portion of Frog below Navicular Bone ; M, Cleft of Frog ; N, N′, Wall of Cleft. FIG. 86.—HOOF NOT PARED, ANGLE TOO ACUTE.—(See *a c*, Fig. 84.) FIG. 87.—HOOF PARED, ANGLE TOO OBTUSE.—(See *a b*, Fig. 84.) FIG. 88.—HOOF PROPERLY PARED, AND AT CORRECT ANGLE FOR SHOE.—(See *a d*, Fig. 84.)

beneath the frog. This continuation, H H′, is named the "bars." The space between these bars and the wall of the hoof is occupied by the sole G G′, composed of innumerable thin horny plates so disposed and connected with the sensitive sole or vascular covering of the coffin bone as to constitute a horny spring of great strength and elasticity. On referring to Fig. 84 it will be seen that this spring extends under the frog (named the horny frog) L, and altogether, in a well formed foot, presents the shape of an arch possessing considerable elasticity.

When, therefore, a weight is thrown upon the coffin bone above, the heel of this bone is pressed down upon the crown of this elastic arch, which bends to the pressure, breaks the shock of a sudden concussion, and recovers itself when pressure has been withdrawn. The same part, namely, the crown of the arch, marked L, in Fig. 85, also aids in protecting the navicular bone from injury under a great strain. It would seem, however, that the Creator of the horse, in the exercise of His great wisdom and foresight to provide against all contingencies, has still further provided against injury of the foot by arranging pads for the bent arch to rest upon. These are two soft bulbous protrusions behind E E′, named the bulbs of the heels, and an oval pad divided by a cleft situated in the widest part of the space between the bars and separated from them by the commissures K, K′. This is named the cleft of the frog, marked M and N, N′, in Fig. 85, and K in Fig. 84.

Having thus made ourselves acquainted with the various parts of the horse's hoof as shown on paper, let us next take a real hoof in hand, and, having provided ourselves with a farrier's set of tools (see

Figs. 89 to 94), proceed to prepare the hoof for a shoe. If the hoof is that of a young hitherto unshod horse, we shall only require the knife, Fig. 89, and rasp, Fig. 93, and with these proceed to level the hoof. The process of levelling is one deserving close attention. An experienced farrier will turn up a foot and tell at a glance how much horn should be cut from the wall of the hoof to level it; but the novice will do well to proceed carefully by the aid of the following instructions. Fig. 86 shows the hoof with an angle too acute for shoeing. It must, therefore, be pared down to that shown at Fig. 88, which shows the hoof pared down to an angle of about 50°. The angle may be reduced down to 56°, but should never be allowed to obtain an obliquity of 45°, nor so obtuse as that represented in Fig. 87. The first fault is likely to cause broken knees, and the latter an incurable lameness resulting from injury to the bones of the foot.

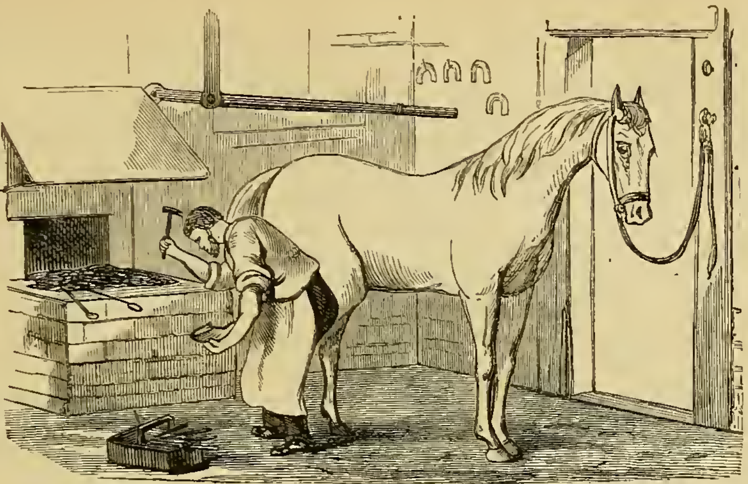


FIG. 101.—SKETCH SHOWING PROPER MODE OF HOLDING HORSE'S LEG WHEN SHOEING.

First cut away all ragged horn from the wall at the quarters and toes, then clear away with the knife all dead horn around the outer and inner heels D′ and D″. Particular attention should always be paid to this, and all dead horn carefully removed, for this is liable to cause hard undergrowths, termed "corns," which press on the sensitive membranes, and, bruising them, cause lameness. The same remarks apply to the inside corners of the bars, which should be cleared of dead horn.

FIG 92

FIG 95

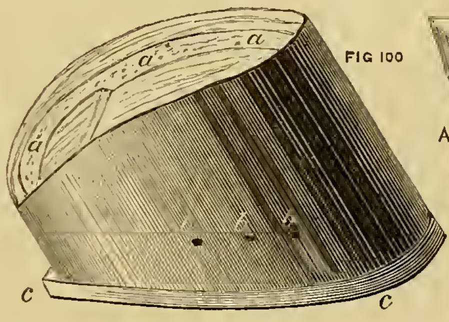


FIG 100

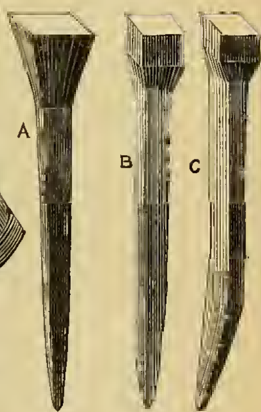


FIG 99

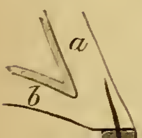


FIG 98

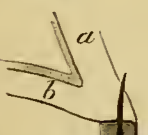


FIG 97

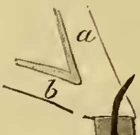


FIG 96

FIG 94

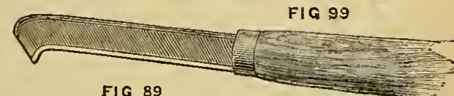


FIG 89

FIG 90

FIG 91

FIG 98

FIG. 89.—FARRIER'S KNIFE. FIG. 90.—TOOL FOR CUTTING CLENCHES. FIG. 91.—PINCERS. FIG. 92.—CLAW HAMMER. FIG. 93.—RASP. FIG. 94.—TOOL FOR STARTING STUMPS OF NAILS. FIG. 95.—HORSE'S HOOF UPTURNED AS FOR SHOEING. FIG. 96.—SECTION OF PART OF HOOF SHOWING EFFECT OF NAIL BADLY POINTED. FIG. 97.—DITTO, SHOWING EFFECT OF NAIL WELL POINTED. FIG. 98.—DITTO, SHOWING EFFECT OF NAIL NOT BENT AT POINT. FIG. 99.—HORSESHOE NAILS—A, Old Style; B, Modern Style; C, Same, with point bent for drawing. FIG. 100.—HORSE'S HOOF LIGHTLY SHOD—*a*, Coronary Glands; *b*, Clenches of Nail; *c*, Shoe.

The triangular space between the bars, from their points backward to the bulbs of the heels, does not require attention from the knife. It contains the horny frog and its elastic pads. The growth of horn in these parts is very slow, and they naturally throw off by exfoliation all dead horn. After a horse has been shod a few times, this part of his hoof will be seen to diminish in size, and become less prominent without the aid of the farrier's knife. All *cutting* of the frog must therefore be avoided, and operations thereon confined to merely a few touches with the curved part of the knife, to remove any dirt or gravel that may have got lodged in the crevices. The practice among some persons of cutting at those parts to "open up the heels" cannot be too strongly condemned. Nature will open up the heels far too soon for the animal's comfort and well being after man takes the hoof in hand.

The hoof having been levelled, we must next fit the shoe to the foot, and shall find it necessary to use the rasp on the toe and outside edges, to make those parts fit the shoe. A few touches with the knife may also be required, for the shoe should fit level and bear evenly all round. When this has been done, proceed to nail on the new shoe, driving the nails into the hoof in such a manner as to cause their points to come out a little through the wall on the outside, as shown in Fig. 97. When all the nails have been driven, their points must be clenched by holding the pincers (Fig. 91) under the head of each nail, bending the point down with a few light blows from the hammer, rasping off the extreme point, and closing the remainder down on the hoof with the hammer. Should a nail turn out too soon, as shown at Fig. 96, or run in, as shown at Fig. 98, the offending nail must be withdrawn with the claw of the hammer or the pincers, and another nail substituted with extra care. Finally, run the rasp around where any roughness appears, and finish off in a workmanlike manner.

The first thing to be done to the hoof of an old horse requiring to be re-shod, is to take off the old shoe, or, if this is already off, to take out the old nails. In either case the clenches must first be removed, and this is done with the tool shown at Fig. 90. The hatchet-like edge of this tool is placed hard down on the hoof under the clench, and the edge is then driven with the hammer upwards until the clench is cut off or driven upward in a straight direction. When all the clenches have been thus loosened, the old shoe is wrenched off, or the old nails withdrawn with the pincers. It is often necessary to notch the hoof with the rasp under the clenches before these can be cut, and to start worn nails back with the tool, Fig. 94, before they can be drawn.

In levelling the hoof of an old horse, particular attention must be paid to the angle of the hoof before we attempt cutting off superabundant horn. The growth of the wall is not the same in all horses. Some make horn at the toes very fast, others have a tendency to make a stumpy foot, similar to that shown at Fig. 87. In the first case, the obliquity of the hoof must be reduced as already directed, but in the latter case the reverse treatment must be adopted, and the hoof made shapely by cutting down the quarters and heels, leaving the toes almost untouched. But, in all cases the actual growth of horn must be noted, and sound judgment exercised respecting the quantity of horn to be removed, for great injury to the foot may ensue from paring the horn too close, as may be easily seen on consulting a section of the foot, as shown at Fig. 84. Respecting the practical part of this work, more may be learnt by watching a farrier for a half-hour than can be possibly taught here, whilst knack in using the tools and handling the hoof can only be acquired by practice.

Horse shoes, and nails for the same, may now be bought ready-made if desired, but it would be foreign to this work if I recommended this course without giving a few words of instruction on their home manufacture. As, however, time and space is limited, I must confine my present remarks to nails, and defer those on making farrier's tools and horse shoes to my next article.

When I was a boy, and played about country smiths' shops, the worthy smiths used to make their own horse-shoe nails, either from the very best nailing rods—rods of iron made on purpose for nails—or from nail rods made by themselves in leisure moments from old nails. Old horse-shoe nails were made up into faggots with scraps of nail rods and iron binding wire, and the faggots thus formed were heated to a welding heat in the forge fire, the parts well welded together, and then drawn out into rods. In those days the approved form of nail was that shown at A, Fig. 99. This was made by hammering out the pointed part from a heated rod on the anvil, nicking off the length on the sett, then driving the head into a "nail-former." This old-fashioned shape has been long proved defective, because the taper head wears loose in the shoe, and often breaks off when the shoe is half worn out. The right shape is shown at B, Fig. 99. This is secured by having a less taper countersink in the nail-former, by having the nail rod the exact size of upper part of head, and by nicking off just enough metal to properly form the head. Horse-shoe nails are made by expert smiths with the aid of a light hammer and sett alone; the shoulders being accurately formed with the hammer, and the head left rough as cut off with the

sett. Nails sbould be made of the very best nail rods procurable, in sizes to suit all classes of work, from the lightest shoes upwards, and of the shape sbown at B, Fig. 99. The usual lengths are $1\frac{1}{2}$ inch, $1\frac{3}{4}$ inch, $1\frac{7}{8}$ inch, 2 inches, and $2\frac{1}{2}$ inches. Bought nails are numbered from 1 to 10, according to size. In making nails, draw out the nail from the beated rod on the anvil to shape, cut off by holding it on the sett and giving it a blow with tbe hammer, then let it fall down among the scales at the foot of the anvil block. The nails must not be cooled too suddenly by falling on iron, nor allowed to cool in a heap, but scattered about on the scales or ashes, else they will be brittle. The finishing toucb is given to them when cold on a small anvil held in the vice, using a light bammer for the purpose. Here the rough heads are toucbed into shape, and the points sharpened by bammering, after whicb the points must be bent a little, as shown at Fig. 99, C, to ensure tbem a right direction when being driven into the hoof. If the point is bent too much it will come out too low down in tbe wall to be of any service, as shown at Fig. 96, and in sucb a case must be witbdrawn, for, if left thus, the nail will break tbrough the hoof and spoil the wall. If the point is not bent at all, it is liable to run straight up between the fibres and be embedded in the wall, as shown at Fig. 98. A nail thus driven would be useless, and might cause much mischief, for it is possible that it would not take up the safe position shown in tbe sketch (where the wall is represented thicker than it should be), but turn inward and toucb the sensitive laminæ of tbe wall, causing the animal much pain. It is, therefore, of the greatest importance that the nails be properly pointed to ensure their points coming out at the right position on the hoof to make safe clenches, as shown at *b*, *b*, *b*, Fig. 100.

This illustration is taken from "The Smithy and Forge," a useful little book by W. J. E. Crane, publisbed at 3s., by Messrs. Crosby Lockwood and Co., 7, *Stationers' Hall Court*, *London*, and some of the other illustrations that appear in this chapter have been adapted from this source. I am also indebted to Mr. Crane's book for some useful hints on the farrier's art, originally set forth by Mr. William Miles, of Exeter, wbo has written some excellent works on the subject. The illustration given in Fig. 101 is merely intended to give the amateur smith an idea of the proper manner of holding the leg of a horse when engaged in putting on a shoe. The well-known picture by Landseer, of the interior of a smith's forge, with the smith himself shoeing a horse, will occur to many as an excellent example of the method of carrying out this important branch of smithing.

(*To be continued.*)

HANGING BOOKSHELVES FOR THE THREEPENNY LIBRARIES,

IN SLIGHTLY CARVED FRETWORK.

Specially Designed for AMATEUR WORK, ILLUSTRATED,
By J. W. GLEESON-WHITE.

IN all the special gifts which the year has offered to us, there is perhaps not one more noticeable, and less open to objections, than the issue of cheap literature in handy form; but while conscious that at last England has redeemed her position in thus placing the highest order of literary work within reach of all, it must not be forgotten that France and Germany, have for many years past provided similar libraries for the people; and although the English issues are superior in printing and paper to their continental fore-runners, yet it leaves an impression of regret, that the country of freedom of thought and religion was not the one to lead the van in such a good undertaking. But now that it is an accomplished fact, it seems that the publishers are bent on making up for lost time, as already Messrs. Ward, Lock and Co., Cassell and Co., Routledge and Sons, and the Religious Tract Society have each started the issue of a series of reprints of classical and standard authors of the past, at the uniform price of 3d. per volume in paper, or 6d. in cloth bindings, which healthy rivalry, whatever it may mean to the publishers, is likely to be an unmixed good to the public.

The love for reading is daily spreading. We have not yet felt more than the first tiny ripple of the great wave of education that has been preparing our sons and daughters to take their place in the mighty army of readers; and imagination itself can hardly grasp the requirements of a future population of the vast English-speaking race, all ready and desirous, not only to read, but to possess books of their own: for there can be but little doubt that almost the first impulse when the love of reading is fully acquired, is to be the owner and not merely the borrower or hirer of books. Of late years, we are told that the great circulating libraries have exercised an influence, not altogether for good, as the love of buying books among the upper classes has not increased in proportion to the growth of less necessary luxuries (if the phrase is allowable), and with the enormous advance in the consumption of all art objects, china, pictures, bric-a-brac, etc. The library has been too often a borrowed one. This cannot be for good, as the books which are worth reading once, are nearly always even more delightful on the second and following perusals; and not only so, but the chance of dipping into a favourite work at will, possibly for comparison with another, or to verify a quotation, is not feasible if the books are

HANGING BOOKSHELVES FOR THE THREEPENNY LIBRARIES IN SLIGHTLY CARVED FRETWORK.

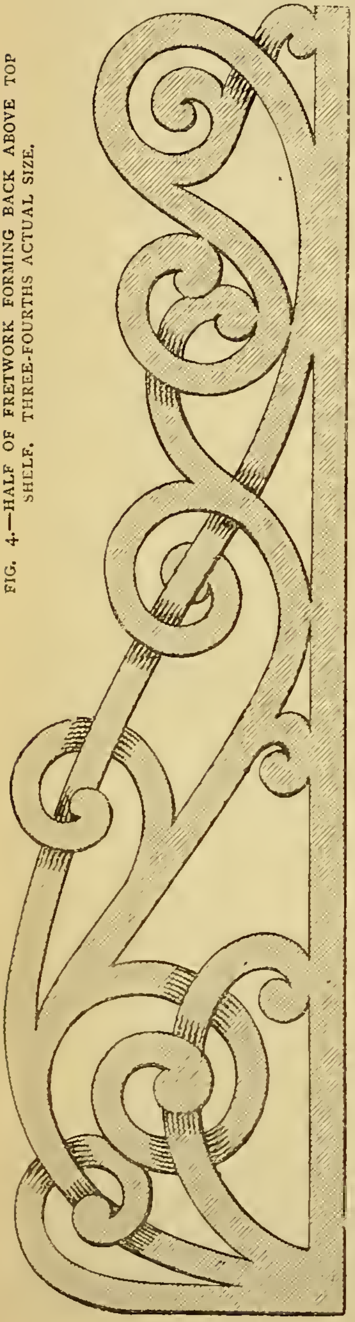


FIG. 4.—HALF OF FRETWORK FORMING BACK ABOVE TOP SHELF. THREE-FOURTHS ACTUAL SIZE.

FIG. 2.—UPPER PART OF SIDE-PIECES. THREE-FOURTHS ACTUAL SIZE.

kept merely so long as the first reading requires. It may be that the rising democracy so much dreaded or welcomed, as the case may be, will no longer tolerate this, and the demand for literature at popular prices will be so great, that, in their own interest, the book producers will issue a new work by a famous man somewhere near the price we can now obtain reprints of the older authors. It seems a pleasant dream to hope for the time when a man of limited income, on reading a review of the last work by Tennyson, Spencer, Farrar, or the famous novelists, may no

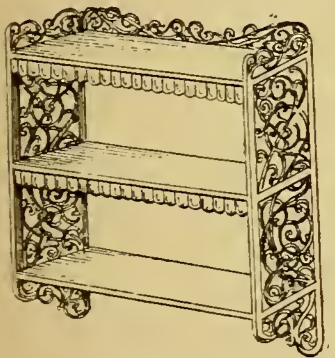


FIG. I.—PERSPECTIVE VIEW OF HANGING BOOKSHELVES FOR THREEPENNY LIBRARIES.

longer have to wait his turn at a library (not always within the reach of many book lovers who live away from the great centres), but will be able to invest his modest sixpence or shilling, and take the book, his own, to read, lend, keep, or destroy, whatever be his will.

But having got our cheap books, the next question is, whether they are not worthy of care in keeping them clean and in order, out of the way, yet always available. That many require a more permanent binding, is true, but other papers in AMATEUR WORK have provided the necessary instruction for this part of the work, so it is only

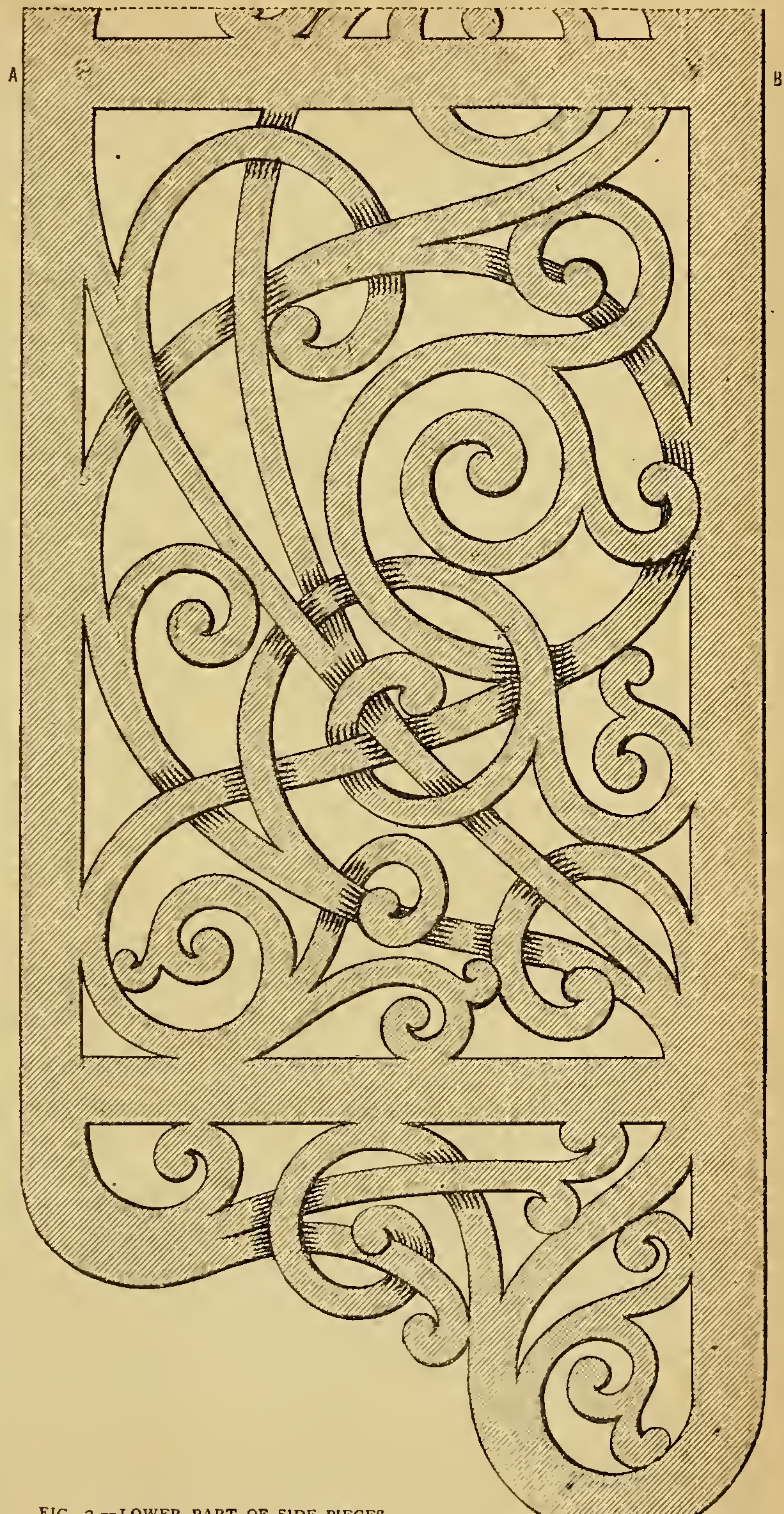


FIG. 3.—LOWER PART OF SIDE-PIECES. THREE-FOURTHS ACTUAL SIZE.

needful to refer to them, if the buyer of the cheap editions wishes to be also their binder.

For the purpose required, namely, to keep these little volumes in order, I think the plan of small hanging bookshelves for each series will be found as good as any, as they are easy to construct, and can be placed within reach in any room, while preserving the contents from injury, and also separating them from the larger series of ordinary books, where they come somewhat as an intrusion, both size and style looking cheap and small beside the library editions.

The size has been specially planned to take the larger of the various series named, that of Messrs. Ward, Lock & Co.; as it is evident that as the less cannot contain the greater, if this series of Literary Treasures can be put on the shelves, either the slightly smaller of Messrs. Routledge, or the smallest ones of Cassell's and Religious Tract Society can also be accommodated. These little books, especially the paper-covered issues, make an ordinary bookshelf look untidy, and slip out of sight among the larger volumes there. It is suggested that the shelves shall be fitted to take either series exactly, or in the lesser ones, that the hanging border should be somewhat deeper, and a strip of wood fixed on the shelf at the exact distance required, to stop the smaller sizes from retiring too far from the edge of shelf, where all books look best if drilled to a uniform rank, like a row of soldiers.

The shelves may be enriched or plain, with or without glazed doors. The one illustrated is for the amateur to exercise some little decorative skill, and to make the case itself an ornament. The style chosen is of simply carved fretwork, to detach the ornament, but this carving is not absolutely necessary; the design has been purposely arranged that the mere fretwork shall have a decorative effect, if the carving is from any reason impracticable. Those who have studied the wealth of native work at the Indian and Colonial Exhibition, will see carved fretwork in its most beautiful form. I do not think the greatest purist could object to this substitute for carving in the solid, used as the Indians use it. It may be, for all I know, actual pierced solid carving, but the effect is almost precisely that of carved fret-cut woodwork, and the use of the carving tool, in many cases, seems limited to the simplest treatment, almost within the reach of any handy schoolboy with his pocket-knife (and brains, one forgets that important item in all art work), and a piece of cleanly-cut fretwork sufficiently firm to stand a little hacking and slicing.

The deluge of cheap Swiss carving that flooded the country a few years since, disgusted many, I fear, with this treatment of wood; but the Indian show will soon prove that it was the design, not the material, which was really the cause of the unpleasant, cheap, and nasty effect of so much of the common Swiss work.

The bookshelf illustrated is intended to be made in stuff not less than $\frac{1}{4}$ inch thick, if possible a little thicker would be better. After the fretwork is cut, the carving, which is so slight as to be hardly worthy the name, may be done with a sharp chisel and pocket-knife, if the proper tools are not at hand. As varnished carving is an abomination, a wood that does not need polish should be chosen—American walnut, with its clean, close grain would be the best, and ordinary oak almost as good. If other wood is preferred, Stephens' Ebony Stain, applied after the work is finished, gives just the right effect, being almost exactly the colour of old carved oak, with a mere suspicion of glossy surface. The shelves and back are of plain wood, the sides and top carved, the fitting of the whole with screws, to take apart easily for packing if required. The shelves are finished with a piece of the ordinary stamped leather border sold for the purpose, or cloth "pinked" out to pattern will answer equally well. The fretwork need not be lined, unless in thinner wood, then it might be necessary to mount the side-pieces on the actual wood framework, using the fretwork simply as decoration, in this case it would be best to line the open pattern with silk, or let the wood for the shelves and their uprights be the same as the cut-out portions.

So elementary a piece of carpentry needs no other description, as any one with power to cut the fretwork may be credited with the needful knack of fitting it together.

A PHOTOGRAPHIC ENLARGING CAMERA:

ITS CONSTRUCTION AND USE.

By CHAS. A. PARKER.

(*For Illustrations see the Folding Sheet issued with this Part.*)

I.—THE APPARATUS.

IN this paper it is my intention to give in detail an instructive, and as far as is possible, clear, and complete account of the manner in which an amateur can easily construct a photographic enlarging camera, if he possesses ordinary skill and a few tools. The method I am about to describe is for artificial light, and the apparatus is extremely simple and convenient to use, giving results equal to any other process of enlarging. I presuppose that the amateur has arrived at that most important stage in the study and practice of photography, namely, the ability to produce a *good* negative. As the making of an enlargement is a distinct advance upon this, in

this and the following article I purpose showing him how the apparatus requisite for the enlargement of his best negatives may easily be constructed, and the most tiny negative may be enlarged to very imposing dimensions.

With this brief introduction, I will now proceed to the actual task that I have set before myself, merely premising that throughout I shall endeavour to keep in view two objects—namely, simplicity and completeness. There are various methods of enlargement, some requiring large and expensive apparatus, but this enlarging camera will require but little additional apparatus, from that employed for every day work. A pair of five or six inch condensers, mounted in brass are the principal items ; cost, according to the size negatives that it is wished to enlarge from. Should the negative to be enlarged from not exceed quarter-plate size, five inch condensers will do, costing about 30s.; but if the negative be half-plate, the condenser must be at least 6 inches in diameter, and will cost about 40s., unless obtained secondhand. Fig. 21 is a section of the condensers, and shows the manner in which they are mounted in brass. A symmetrical or portrait lens may be used with the camera ; if a portrait combination is used, the back of the lens should be towards the negative to be enlarged. But if a symmetrical lens be employed, it is not important which end of the lens be placed towards the negative, as both lenses are alike ; but with a portrait combination, the front and back lenses are totally dissimilar. A three or four-wick refulgent lamp will be required; one of Hughes' triplexicons will be found to give great satisfaction.

The camera can be made of deal, but mahogany is far preferable, and should at least be used for the lantern ; but if the apparatus is made of mahogany with 6 inch condensers, and is well finished and French polished, it will then be equal to one costing about six or seven guineas. It will be as well for me to commence with the making of the bellows, which I will endeavour to describe in as clear a manner as possible. To manufacture bellows, which in our case will be rather large, is to first make a box 18 inches long, 9 inches square, of ½ inch deal. One of the sides of this box is to be made of three boards grooved together, the centre-piece drawing out so that the sides collapse a little, and so enable you to draw the bellows off when finished, for without this contrivance it would be rather difficult to get them off when of a great length. Two back-pieces must be fixed on the sliding-board, which when in its position should be screwed to the other sides, so as to be as firm as if it were constructed of one piece. No ends need be put on this box, but two strips of wood should be placed diagonally so as to keep all square and rigid, but so that the bellows can be drawn off when finished. This box can be made of deal, as when the bellows are complete there is no further use for it.

Having got the box ready, the next proceeding is to cover it with black twilled calico, letting the ends overlap about 1½ inch, and paste them together with strong paste composed of barley flour made with boiling water, and stirred till quite smooth ; this paste is much stronger than that made with ordinary flour. Now prepare a sufficient number of strips of three sheet cardboard, cut to about ⅝ inch wide, and ⅛ inch shorter than the widths of the sides of the box, cut the angles off a little more acute than 45°, so that when the bellows is closed up the angles will just clear each other. Commence now to paste on the above pieces to form the folds of the bellows, having the end of the box towards you. Lay on the piece with the angles cut off towards you, the second piece ⅛ inch distant from the first, and the third and succeeding pieces at a similar distance, so that when finished the bellows will fall in their proper folds with ease and exactness. The manner of placing the strips of cardboard will easily be understood by consulting Fig. 2. After these strips are laid on one side to the extent of the bellows, proceed in a like manner with the other three sides, after having allowed about ½ inch at each end for gluing to the camera, being particular as you go on to keep the pieces parallel with the end of the box ; for this purpose have by you a carpenter's rule so as to measure the distance of each strip of cardboard from the other, and thus see that both ends progress alike, exercising the same care with the sides ; also, it will be found advisable to paste both sides of the cardboard so that it will lie flat to the box. After all the sides are covered, paste on the outer cover of twilled calico, which is not obliged to be black, but the inside must be ; dab it down well so that it is not full of wrinkles. The part where it joins should be on the same side as the join of the first piece, but not exactly on the same spot, or it would be too thick, and interfere with the folding of the bellows. The bellows must now be left to get thoroughly dry, while some other part of the apparatus is being made. It is best to leave it for a day, and then the screws can be unloosened from the sliding piece in the side, and after being drawn out, the two adjoining sides can easily be bent inwards sufficient to allow of the bellows being drawn off without any trouble at all.

The next thing to be done is to fold them, being careful to get the corners put right. The best thing to do is to practise first with some stiff paper that has been folded and glued to resemble the bellows. At first it will be found rather difficult, especially to

get the corners to look well, but a little practice will soon put this right. When they are properly folded, lay them on a flat board with the heaviest weight at hand on top, to remain there till it is requisite for them to be glued to the camera.

The other bellows of the Kinnear form may be as readily made, although they are perhaps a little more trouble to fold. A box must be made taper form, 8 inches square at one end, and 6 inches at the other, length to be 9 inches ; the sliding board will not be required for this box, but the cover of black calico that is first laid on must be fastened to the 8 inches end of the box, otherwise it would slip off before it is required.

Now construct a box, Fig. 3 ; measurement, 10½ inches by 9½ inches, and 6 inches deep of ½ inch wood. The front D, to which the lens is fixed, should be a nicely marked piece of wood, and must be glued and screwed carefully, as this is the part of the apparatus that catches the eye first ; therefore, the maker should be particular that it is well finished, as it improves the look of the apparatus when complete. A very good joint for the woodwork may be made by adopting the one shown in Fig. 4. Another method is shown in Fig. 20, but it takes longer to make. When this box is finished it must be cut in half to measure 3 inches each piece. The half that has the front D in it must now be cut in half again to measure 1½ inch in each piece, the three pieces measuring when put together (as in Fig. 3) 6 inches. It will be found advisable to make the box 7 inches deep, as after sawing to the required sizes, it can easily be planed down to 6 inches. An opening E, 8 inches by ¾ inch is to be made in one side of section B ; this is for the carrier, Fig. 5, to slide along. (It will be found advisable to make this opening before the box is cut up, otherwise the wood may be apt to split.) The carrier may be made of one piece of wood if the amateur possesses a fret or circular saw, or it can be tongued together in the usual way ; a ⅜ inch rebate is to be cut in the centre of opening, so that the plates to be used just slip in, and it would be best to make it for half-plates (6½ inches by 4¾ inches), with ⅛ inch rebate for the plate to rest against, then make two brass clips, Fig. 6, and place one of them on each side of the rebate, so that when the plate is inserted in the carrier, these clips can be turned round so as to keep the plate in its place ; the position for placing these clips will be seen by A and B, in Fig. 5. The carrier to measure 8 inches by 8½ inches, ½ inch thick. At one end must be fixed a piece of wood the same size as the opening E in the camera ; in fact, it should be fitted to that, and then screwed to the carrier. Measurement will be 8 inches by ¾ inch, ½ inch thick, and should have a rounded end ½ inch thick glued on to it to form a handle (see Fig. 5, C); a section of the carrier will be seen by Fig. 7, showing the end fixed on. Another carrier can be made for quarter-plates (4¼ inches by 3¼ inches), and planed down to ⅛ inch in thickness, and placed in the opening for the half-plates, just the same as if it were a plate, the same being done for lantern size, thus enabling the enlargement from any size plate.

Now construct two frames as Fig. 8, 8¾ inches by 9⅝ inches, ½ inch thick, with opening 6½ inches square. Now get two strips of wood, 8¾ inches by ¾ inch, ⅝ inch thick, and place them top and bottom of one of the frames, as shown by the shaded part of Fig. 8 ; they must be 8⅛ inches apart. Now glue the strips in their place, and glue the other frame on the top, so that when finished there is just room enough for the carrier to pass along the slit thus made without allowing it to shake about. It should now be glued in to the section B of the camera, and the carrier slid through the opening E, in order to keep the frame in position till dry.

It will be as well now to make the frame for holding the condensers. Make two pieces 8¾ inches by 9⅝ inches, ½ inch thick, with a circle cut in the centre of each, to be governed by the size condensers it is intended should be used. The two frames are to be clamped together by four strips of wood, 1 inch wide, placed in the form indicated by the dotted lines in Fig. 9. When finished it should be 2 inches thick, and a piece of velvet must be glued all round the inside of the circle, so that the brass of the condensers is not scratched. This circle could be turned in a lathe from a solid block of wood, 2 inches thick, cut to the size, and the velvet glued inside just the same. This frame of wood when ready is to be screwed in section C of the camera in the position shown by the dotted lines, Fig. 3. Eight brass clips must now be filed up in the form of Fig. 10. They are required for securing the camera when not in use, and are placed as shown in Fig. 1. They are drawn actual size, half inch ; brass screws with round heads, should be used for fixing them.

The next thing to manufacture is the lantern body. First make two sides of mahogany, measuring 9 inches by 8 inches, and ½ inch thick, four holes to be drilled with a brace, using a ¾ inch or ⅞ inch bit. These are intended for ventilation, and must be carefully drilled, and all splinters cleared off ; the sides also nicely planed ; the wood used for the lantern body must be of mahogany, even if the rest of the apparatus is not. There is no necessity to use anything but deal for the frames that the carriers slide through, or the frame for holding the condensers, as when the apparatus is complete, some dead black should be

applied to them. Fig. 22 is a section of one of the lantern sides, and shows the manner in which this and similar portions of the woodwork should be made. Fig. 11 is the bottom (or floor) of the lantern, which is a piece of wood 8 inches by 5 inches, ½ inch thick, with two strips of brass screwed lengthways to form runners for the lamp to slide along (that is, supposing it to be a refulgent lamp).

Now make a piece of wood to the form of Fig. 12; this is the part of the lantern to which the smallest end of the Kinnear bellows are to be fixed; it must measure 5 inches by 10 inches, ½ inch thick; a circle must be cut out 4 inches in diameter, the centre of the circle to be 6 inches from the bottom (along the dotted line in Fig. 12 will explain what is meant). Three holes must be cut near the bottom for ventilation, ¾ inch in diameter (the top of this end of the lantern body, also the door, must be arched, as in Figs. 12 and 13).

The next thing to be done is to make the sliding door; the measurement of this is to be 10 inches by 5½ inches, ½ inch thick; 5½ inches it will be seen allows ¼ inch at each side to be left for a rebate, which should be made to fit in two grooves in the sides of the lantern body; they should now be cut, and the door fitted to them. A hole must also be cut at the top of the door ¾ inch in diameter, for the purpose of raising or lowering it when required; for plan of the door, see Fig. 13. Both of the ends of the lantern must now be lined with tin-plate; this lining is necessary, as it protects the wood from the heat of the lamp. The size required for the door will be 9½ inches by 4½ inches; several holes must be punched in it to allow of its being nailed to the wood. There will be no need to cut a hole in the top of the tin as there is in the door, but the tin must be rounded at the top the same as the door. The tin-lining for the end of the lantern to which the bellows are fixed can be cut to the form shown in Fig. 14, as it would be rather awkward to cut four circles in a piece of tin this size satisfactorily.

The next part of the apparatus to be made is the tin body of the lantern, which is intended to be bent to the form of an arch, enclosing the lamp. Procure a sheet of tin measuring 23 inches by 8 inches, then ½ inch must be bent over the whole length and hammered flat. An opening must now be cut in the centre, measuring 4½ inches by 2 inches, and ½ inch of the tin hammered down all round this opening, so that when it is finished it presents the same appearance as Fig. 15. The sides can now be fixed to this tin body, and the lantern put together. To do this take one of the mahogany sides of the lantern, with the ventilation apertures towards you, and the groove for the door to slide along on your right, then take the tin body just made with the part that has the ½ inch turned down the whole length uppermost on your right, then nail it to the wood firm; and then take the other side and nail the tin body to that also, being careful to observe that the grooves for the door are both on the same side; that part of the tin that is over the ventilation apertures must now be bent to right angles. To do this take a piece of wood about 9 inches long, and place it in a straight line just above the ventilation apertures, and about the same position inside the lantern, as the dotted line in Fig. 1. Press it down hard with one hand, while with the other the tin is bent up to right angles. Now take another piece of wood that is ½ inch thick, and place it over the apertures and against the tin just turned up, which is now to be hammered down over this piece of wood. By making the tin body as described, the air is allowed to enter the lantern without any light shining from the openings; this will be better understood by consulting Fig. 16, which is an end view of the lantern.

Now take the end of the lantern (Fig. 12), and bend the tin body round it, then glue and screw them together. (*Note.*—The tin is not intended to overlap the ends, but must terminate on the inside of the lantern, just level with the rounded ends of the door, and that to which the bellows are fixed. A and B, in Fig. 1, shows where the tin should terminate.) Now screw the bottom (or floor) of the lantern in, insert the door, to see that it slides along the grooves all right, and the lantern body will be finished.

I should advise the use of a three or four wick refulgent lamp; the chimney would be of the same form as that shown in Fig. 1. It lifts off, enabling the lamp to be slid in and out of the lantern, and the chimney to be replaced through the roof. (*Note.*—The slit in the roof of the tin body of the lantern must be governed to a great extent by the lamp to be used.)

The next part of the apparatus to be made is the baseboard (Fig. 18), to which the lantern is finally fixed. A board is first constructed, size 15 inches by 10 inches, to be planed nice and smooth till it is ⅝ inch in thickness (A, Fig. 17). Now make four strips of wood, size 15 inches by ⅞ inch by ⅜ inch (B, Fig. 17). Then make two pieces, size 15 inches by 1⅝ inch by ⅜ inch (C, Fig. 17); and two more pieces 15 inches by 1⅛ inch by ⅜ inch (D, Fig. 17). These are now to be glued on to the board A, in the position shown by A, B, C, D, in Fig. 17. After having carefully measured each end of the board to see that these strips are placed in exactly the same position, now make two pieces 15 inches by 1½ inches by ¾ inch, to the form of E, Fig. 17, so that they just pass freely along the grooves made for them. The centre-piece (F,

Fig. 17) measures 16 inches by 3½ inches, ¾ inch thick, and one end of it must be dovetailed on to the rounded piece of wood that forms a finish to the back of the apparatus, which should be the same thickness as the baseboard. When the baseboard is finished, then plane it down to 1 inch in thickness, being particular to finish off the edges, and the rounded end perfectly smooth and square; a hole should be drilled in the rounded end (see Fig. 18); it will be found useful when drawing the lantern out, as it forms something to lay hold of.

The apparatus is now finished, and it only remains for it to be put together, having first decided if it is to be French polished, as it would have to be done before the bellows are glued in, and the camera screwed to the baseboard. If it has been made of mahogany it should be screwed entirely with brass screws. Before it is put together all the inside of the camera (not the lantern body) must be made a dead black, as it prevents the reflection of light. The following will be found a good plan: Procure from a chemist in two separate bottles a pennyworth each of tincture of nut galls and muriated tincture of iron. Having got the wood all nicely sand-papered to free it from any grease, it should be brushed over with the nut galls and allowed to dry. When it is quite dry it should be brushed over with the tincture of iron, when it will at once assume a splendid and lasting dead black. Very useful for all kinds of woodwork.

Having now quite finished the various portions of the apparatus, it will be as well to fix them to the baseboard in the following manner: Take the front portion of the camera (A, Fig. 3) and screw it on to the sliding pieces 1 and 2 (Fig. 18) by means of four 1 inch screws, having previously marked the position with a pencil. Now slide this front on to the baseboard again, and place the sections B and C in position, and secure them together by means of the eight brass clips, and then mark with a pencil the position to be occupied on the baseboard by C; then unhook and remove A and B while C is being screwed on by means of eight screws; B is not to be fixed at all, but simply hooks on to C by means of the eight brass clips. The position to be occupied on the baseboard by the camera and lantern, also the manner of placing the screws, will be seen in Fig. 18. The centre-piece on to which the lantern is fixed should now be drawn out and the lantern body screwed on, the back having the sliding door being placed just where the rounded end commences. Two 1 inch screws will be sufficient to fix this, and should be placed as shown in Fig. 18. Before gluing the bellows in, just look well over all, and any screws that project should be filed off; also, be particular that no splinters are left sticking about. It will be found advisable to just place the apparatus together to ascertain that it all slides right before fixing the bellows in, as it would be found awkward to make any alterations afterwards.

Now take the front of the camera (A, Fig. 3) and glue one end of the 8 inch by 16 inch bellows to the inside of the same. Stand the camera, front downwards, push in the bellows flat, and place a weight on the top to keep them in position till dry. The other end must then be glued to the frame that is fixed in section B of the camera, and put aside to dry. The frame that carries the condenser must now be taken out of section C of the camera, and the large end of the Kinnear bellows glued to one side of it; then put it aside to dry, while a frame is being made, 6 inches square, the width and thickness to be about ½ inch (Fig. 19); to this the small end of the Kinnear bellows are glued. When dry the frame should be placed in position inside C, and fixed by four brass screws, the small end of the bellows being screwed to the lantern body from the inside.

Before concluding my description of the camera, a few words with regard to the condenser may not be out of place. It must be understood that the condenser has nothing to do with the formation of the image on the easel. The object of a condenser consists in collecting the greatest possible amount of light emitted from the lamp and projecting it forward in a converging form, the apex of the cone of illumination being the spot where the lens is situated. A condenser is invariably composed of *two* lenses, although generally described as a condenser, but this is on account of three or even four sometimes going to make up a system. The form I allude to, however, consists of two similar plano-convex lenses mounted flat sides out, and so close together as to nearly touch each other in the centre (see Fig. 21). In a condenser such as this, consisting of two lenses, the first one collects the rays of light from the lamp, and transmits them in a nearly parallel manner to the second lens, which in turn conveys them to a distance, equalling the position of the front lens of the object glass. If the eye be placed at the apex of this cone, the whole of the condenser will be seen to be of intense illumination from the centre to edge, all portions being equally bright. A great many amateurs may think that one lens will do, but they are mistaken, as it is impossible to effect the transmission of a large angle of light by the use of a single lens. Therefore, a good condenser must consist of two lenses. But it need not be any larger than will suffice to answer the required purpose, because a larger surface necessitates flat curves, which imply a long focus, and less illumination than when the surface is short.

For enlarging from quarter-plate size in order to

obtain a picture sharp and crisp to the edges, not less than 5 inch condensers should be used, and for cabinet size they may with advantage be 8 inches in diameter. The most perfect system is, when the face of the lens nearest the negative to be enlarged is slightly convex, instead of quite flat. Let the amateur bear in mind that the *sine qua non* is a first-class condenser. With this I think I may safely leave this branch of the subject. In my next paper I will describe the various uses to which we may put our enlarging apparatus.

(*To be continued.*)

A CHEMICAL LABORATORY FOR AMATEURS.

By P. CARMODY, *of the Inland Revenue Laboratories, Somerset House.*

IV.—EXAMINATION OF PAINTS (*continued*)—RED PIGMENTS — BLUE PIGMENTS—GREEN PIGMENTS — BLACK PIGMENTS—BROWN PIGMENTS—VARNISHES —OILS—BOILED OIL—CONCLUSION.

THERE are some very beautiful red pigments, called lakes, which are used chiefly for artistic work. Of these, rose pink, crimson scarlet, and Bismarck scarlet, may be mentioned; carmine also is another favourite pigment. It leaves on ignition but a small amount of ash (about 6 per cent.) The others leave from 28 to 70 per cent. of ash, which consists chiefly of alumina. Its presence may be determined by dissolving the ash in dilute hydrochloric acid, and filtering, if necessary. On adding a solution of ammonia, in slight excess, a flocky white precipitate is formed if alumina is present.

The most important blue pigments are ultramarine and Prussian blue. The blue colour of ultramarine is not destroyed by heat, nor by the addition of concentrated sulphuric acid. Dilute sulphuric acid destroys the colour, so does nitric acid, which causes brown fumes to evolve, and leaves a residue of a foxy tint; so also does hydrochloric acid, with evolution of sulphuretted hydrogen gas—a gas which blackens a paper moistened with a solution of acetate of lead, or other lead salt—leaving a residue of a French grey colour. Prussian blue has its blue colour destroyed by heat, and a foxy red residue is left. Its colour is not affected by strong hydrochloric acid. Prussian blue is sometimes adulterated with chalk and starch. If chalk is present, an effervescence on addition of any dilute acid will be observed. To detect starch, boil in water; if the liquid becomes of a pasty consistence, starch is probably present. Ultramarine is sometimes adulterated with Prussian blue, mountain blue, or indigo. If, when heated, a brownish residue is left, Prussian blue is probably present; a blackish residue indicates the presence of mountain blue; and purple vapours, the presence of indigo. Chinese blue and Victoria blue are other varieties of ultramarine.

The principal green pigments in common use are Brunswick green, emerald green, bronze green, Scheele's green, Schweinfurt's green, and green ultramarine. Brunswick green is an oxychloride of copper, but the Brunswick green of the shops is usually a mixture of chrome yellow, Prussian blue, and a white pigment, usually sulphate of baryta, or chalk. The presence of these can be detected by the methods already described.

Bronze greens are special mixtures, so complicated as a rule as to be beyond the reach of amateurs. The same may be said of the others, with the exception of green ultramarine, which has the same composition as ultramarine blue. The principal black pigments in common use, are, lampblack, Frankfort black, ivory black, and bone-black. Lampblack is the variety most largely used in paints. It is of a dull black colour, and extremely fine—much finer than could be produced by the most elaborate grinding. It leaves scarcely any ash. By agitating a little with a mixture of strong alcohol and ether, and allowing the powder to settle, the presence of an excess of tarry matter, which is objectionable, will be indicated by the darkening of the supernatant liquid. The other blacks mentioned above contain a considerable proportion of ash, varying from about 45 to 85 per cent. It is difficult for a beginner to determine the purity of these blacks, or to distinguish one kind from another. In those used as pigments, the state of subdivision and the tint are the most important properties. Bone black is chiefly used as a decoloriser and deodoriser. The presence of undecomposed organic matter would render it unfit for use; if very dense and compact, its efficiency as a decoloriser will be impaired. If anything is soluble in water it indicates that the samples have not been purified. Boil the sample in water, place a little of the clear water on a clean glass plate, and heat gently; if the water held any salts in solution, they will be left behind as a dry crust on the plate. Generally speaking, vegetable blacks have a bluish or brownish tinge; lampblacks a dull black colour or brownish tinge; bone blacks a reddish tinge; and ivory blacks a velvety black colour.

Black Lead, which is usually sold on the percentage of pure graphite, which it contains, can have its marked value determined only by quantitative analysis.

The most common brown pigments are earths containing iron. They are little used, and seldom adulterated.

Varnishes do not admit of the application of qualitative tests, but a few hints may be of use to amateurs generally. Varnishes may be divided into two varieties—oil and spirit varnishes. The former kind usually contains a large proportion of turpentine, the latter seldom contains any, or only a small quantity of turpentine, no oil, but chiefly methylated spirit, or coal-tar naphtha (for black varnishes). The spirit varnishes dry rapidly, oil varnishes slowly. Any person may distinguish between an oil and spirit varnish by spreading a thin layer on paper or glass, or piece of board. If it dry at once it is a spirit (methylated) varnish, if not for one hour, or upwards, it is an oil varnish. Black varnishes usually take fifteen minutes, or upwards, to dry. Turpentine is added to oil varnishes to lessen the time of drying, but an excess of turpentine is objectionable. The amount of turpentine can be determined by taking a measured quantity in a retort, and heating over an Argand or Bunsen burner until nothing more distils over. The turpentine which distils is collected in a receiver and measured, and its amount thus calculated.

The most important point in connection with varnishes is the character and quality of the gums or resins dissolved in the spirit or oil. These can best be ascertained by spreading a thin layer of the varnish, by means of a camel-hair or varnish brush, on thin, unglazed paper, allowing it to dry, and noting the time taken in drying. By an examination of the dried surface the experimenter will, after a little experience, be able to judge. If the varnish remains tacky, and the paper adheres to the finger, or if it contains undissolved particles which can be seen by holding the surface horizontally before the eye, or if the surface feels rough when the hand is passed gently along it, or if it cracks when the paper is wrinkled, it cannot be considered a good varnish. The colour of the layer should also be noticed. Oil varnishes, made from good gums, dry faster than those made from gums of inferior quality. Good copal varnishes dry in three hours when spread in thin layers. The examination of varnishes should always be directed to testing their suitability to the special purpose for which it is intended to employ them. Other points in connection with varnishes, such as the density, the percentage of driers, etc., can only be determined quantitatively.

The examination of oils cannot well be undertaken by amateurs; but a few hints may be found useful. Oils used for lubricating should be as free as possible from acidity. This may be roughly judged by placing a few drops on a sheet of copper (cleaned immediately before using by rubbing with emery paper), and allowed to remain thereon for a couple of days. The oil is then allowed to drop into a clean white porcelain basin, the last traces being washed from the copper by means of a few drops of ether; a drop or two of acetic acid is then mixed with the liquids in the basin, and then a drop or two of ferrocyanide of potash added. If a brick-red tint appears in the basin, the oil contains free acid, and would be unfit for use in delicate machinery, such as clocks, watches, mathematical instruments, and such like; and the more free acid the oil contains, the more copper will it dissolve, and the redder will be the tint described above. Watchmakers should never use an oil containing free acid.

Painters are often in doubt as to the suitability of a boiled oil. The following hint may be found useful: Place one drop on a sheet of glass, spread out with the finger, worked in a circular direction into as thin a layer as possible, and note the time it takes to dry. If not dry within two days it is not a well boiled oil. Good oils dry in twenty-four hours; but it is not an advantage to dry too rapidly.

With this, I shall take leave of chemical amateurs for the present. Those who have followed the instructions for fitting a laboratory given in preceding papers, will easily find frequent opportunities for utilizing so important an addition to their store of conveniences. The few hints given in the later chapters are intended to point out in what ways the laboratory may be made of practical use. Above all things, keep the apparatus clean, and clean everything as soon as possible after use. Be clean, be tidy, be observant, and you will hardly fail to render your work both agreeable and profitable to yourself and useful to the community.

A FOLDING CHAIR FOR AMATEUR CARPENTERS.

By G. STEPHENS.

BEFORE giving a description of the drawings for a folding chair, I will here mention that part of the work was done in a small lathe, one of the Britannia Company's No. 3, for which I paid £4 5s., and a splendid little machine it is, and I would advise any amateur in want of such an article to invest in one; and, if he has any tact at all, the lathe would soon pay for itself. Now, although part of the work was done in a lathe, and for our present purpose I shall suppose it will be done, still I shall show presently that it can be done very satisfactorily without one. As I have given full dimensions of each part in the drawings, it will only be necessary for me to state here that the framework is made of $1\frac{1}{4}$ inch by $\frac{3}{4}$ inch wood when planed up. Any hard wood will do—beech, birch,

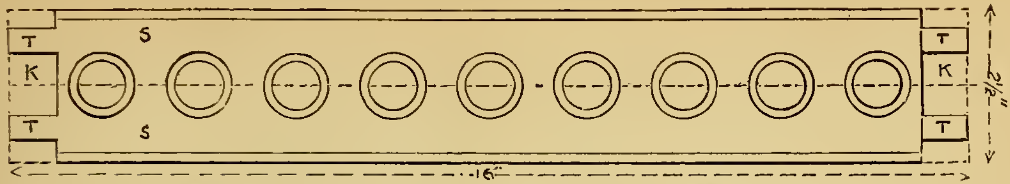


FIG. 7.—MODE OF MAKING TOP RAILS—ENLARGED PLAN OF ARCHES FOR TOP OF CHAIR.

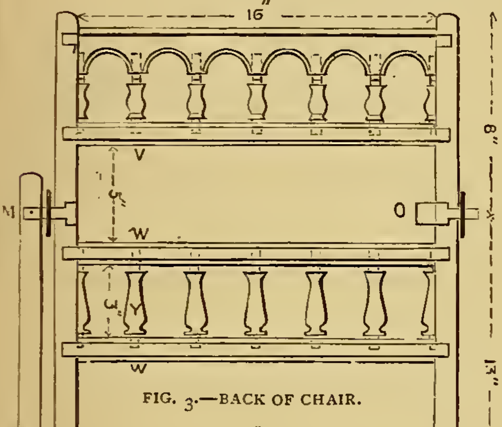


FIG. 3.—BACK OF CHAIR.

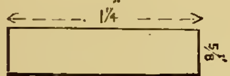


FIG. 9.—PLUG IN SECTION.

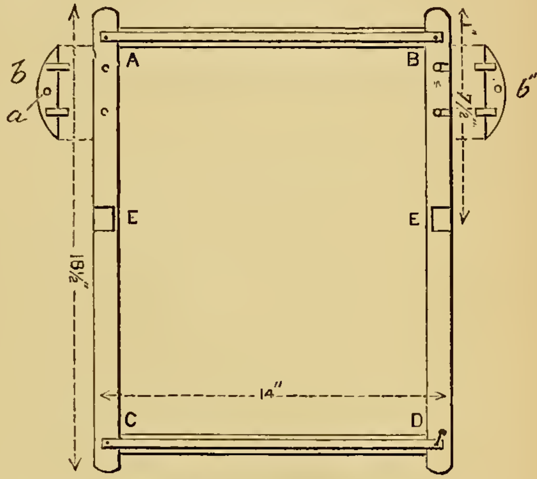


FIG. 1.—FRAME OF FOLDING CHAIR.

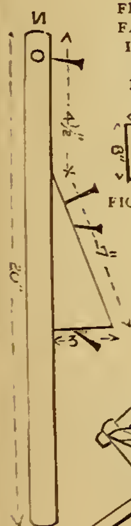


FIG. 4.—FASTENING OF ARM PIECE.

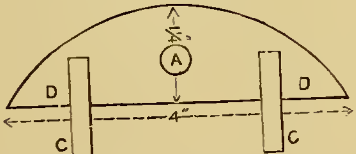


FIG. 6.—ENLARGED PLAN OF *b b'*, FIG. 1.

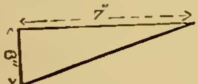


FIG. 10.—ELBOW PIECE.

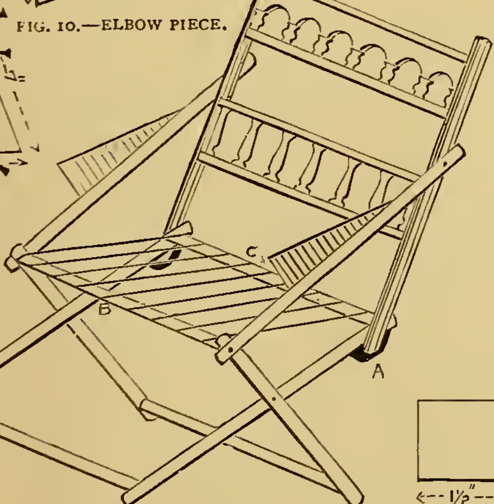


FIG. 8.—CHAIR, COMPLETE.

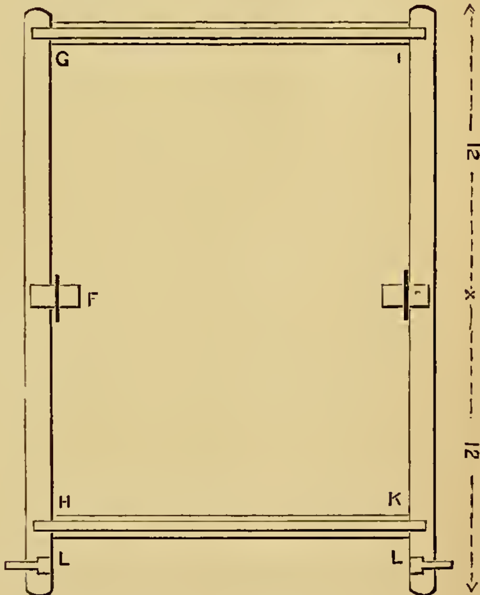


FIG. 2.—PART OF FRAME TO FIT FIG. 1.

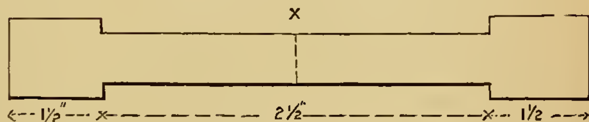


FIG. 5.—BOLT.

ash, or mahogany. I made some of mahogany, and when varnished, they looked very pretty. Some I made of beech, stained black, and picked out with Judson's gold paint. I also ran a $\frac{1}{4}$ inch beading plane round both sides and across the ends of each piece of wood, that is, on the $\frac{3}{4}$ inch face of the wood, which gives a neat finish, and makes the work look light. Of course, it could be chamfered, or even left plain, with just the sharp edges taken off with the plane.

Having said so much in favour of the chair, I hope it will induce many amateurs to try their hand. Always make Fig. 1 first, as Fig. 2. has to be made to fit outside. Before making Fig. 2 it will be better to measure the extreme width of Fig. 1, making a little allowance for the washers shown at F (Fig. 2.) The cross bars are rounded and shouldered, and the holes to receive them are bored with a $\frac{1}{2}$ inch bit (a trifle larger would be better), at 1 inch from the end, that is, the centre of the hole must be an inch from the end. This rule applies to all extreme ends, except at H, K (Fig. 2), where the bolt to fasten the arm is 1 inch, and the cross bar to nail the carpet to is 2 inches. I will here mention how the holes should be bored. Always bore against a piece of brass, or other metal ; this will prevent the bit coming right through, all holes will then be the same depth. Where it is necessary to bore the hole right through, the bit must be taken out and the wood reversed, a little hole will sure to be visible on this side to finish boring the hole. I have found this a useful wrinkle at all times when boring with the brace, as there is no fear of the bit going right through, and making a nasty tear. Bore the holes, A, B, C, D, E (Fig. 1) in this way, as neither of these holes must be bored through. Bear in mind the hole, E, is on the *outside*, into which the plug, F (Fig. 2) fits, and on which the chair folds. This hole should be bored with a $\frac{5}{8}$ inch bit. And now, having fitted A, B, C, D, well glue in, and drive in an inch brad (a wire one is best). This will prevent the cross bars springing out. A brad is shown at D. Now glue and nail G, H (Fig. 2). Place Fig. 1 inside it ; glue and nail I, K. The holes for the bolts at L must be bored half way through with a $\frac{3}{4}$ inch bit, and finished with a $\frac{1}{2}$ inch. This allows the bolt (Fig. 5) to fit in. This bolt is shown as it is to be turned in the lathe, it is then cut in half at the dotted line +. One arm-piece is shown fastened on at M (Fig. 3), and N (Fig. 4), is ready to be put on. I must impress upon you how this is done. Push the bolt in at O, put on a leather washer, measure the depth of the hole, N, cut the bolt same length, glue up tight, and nail. I have shown the head of the bolt at O, long, as it can be sawn off after the arm is fitted. You have now an invisible working joint. The bolts, L, L (Fig. 3) are put into the holes, P, P, in same way. But the holes, P, P, must be the last job, as the chair must be folded up, and the bit put in the holes, L, L, to mark the holes, P, P. Fig. 7 is an enlarged plan of the arches for the top of the chair. Bore first with an inch bit, about $\frac{1}{8}$ inch deep, then bore through with a $\frac{3}{4}$ inch bit, that is, up to the brass plate. Put in 1 inch bit, reverse the wood, and bore out the double arch to match the front. After all the holes are bored, saw through the dotted line, R, R. This will make two tops. A beading along the lines, S, S, will give it finish. Turn up the shoulders, T, in the lathe, bore holes to receive small pillars, shown by the dotted lines (Fig. 3), a piece, V, with corresponding holes about 1 inch wide and $\frac{1}{2}$ inch thick must be made to support bottom of pillars, two similar pieces, W, W, for pillars, Y.

Fig. 6 is an enlarged plan of *b*, *b* (Fig. 1). This piece is put on with dowels, *c*, *c*. Now, I will suppose that there is one amateur amongst all who read this article who does not know what "doweling" is, and for his special benefit I will describe it. Bore two holes, *d*, *d* (Fig. 6) $\frac{1}{2}$ inch deep, make two holes exactly the same depth and distance apart in another piece of wood, make two plugs, *c*, *c* (called *dowels*) 1 inch long. Glue them, drive them into the holes *d*, *d*, and into the corresponding holes. This is called doweling, and the pieces (Fig. 6) have to be doweled on in this way. They are shown in black, A (Fig. 8), now we will suppose that Figs. 1 and 2 are put together, and the back (Fig. 3) ready to go on, with the arm-pieces, M, N, fastened on, dowel on the piece, *b* (Fig. 1), keep the hole, *a*, on the outside, insert half of the plug, shown in section (Fig. 9), put on a leather washer ; now the other half of the plug will fit into the hole, *f* (Fig. 3) ; now take another plug, put it in the hole, *g* (Fig. 3) and into the hole, b^2 (Fig. 1). Glue the dowels and the faces of the wood that come together, and force in the dowels. This can be best done by putting it in the vice. These pieces are doweled on to allow the back to fold up, otherwise a *curved* piece of wood would be necessary. The elbow piece (Fig. 10) is shown partly nailed on to arm-piece (Fig. 4). It is covered with carpet to match the seat. From B to C (Fig. 3) is 14 inches. The leather washer can be cut out of an old boot with the brace, thus : mark a circle with a 1 inch bit, then drive a smaller bit right through to fit bolt or plug. Any amateur not possessing a lathe, and no means of getting the different parts turned for him, could use iron bolts and nuts. The back could be made of bent strips, as seen in most garden chairs. To shoulder the cross-pieces in on the round, first strike a circle with the bit, place the compass in same circle, then strike it out on the end of the piece of wood that has to fit the hole. The rest can be done with the saw, chisel, and sand paper.

NOTES ON NOVELTIES.

By THE EDITOR.

56. Carson's Original Anti-Corrosive Paint. 57. Standring's Statistical India Rubber Table. 58. Zilles' Designs for Fretwork, Carving, Etc. 59. Hardy's Self-Extinguishing Patent Benzoline Lamp. 60. Noble's Expanding Mandrel. 61. Winn's Improved Malleable, Self-Centring Vice. 62. Kolb's Common Sense Screw-driver.

56. CARSON'S ORIGINAL ANTI-CORROSIVE PAINT.—Readers of "Amateurs in Council," page 527, will notice a strong testimonial from a correspondent in favour of the "Original Anti-Corrosive Paint," manufactured by Messrs. Walter Carson and Sons, *La Belle Sauvage Yard, Ludgate Hill, London, E.C.*, and 21 and 22, *Bachelors' Walk, Dublin*, which latter address I append because it may be useful to many of my Irish readers. The correspondent to whom I have referred is a gentleman on whose opinion I place entire reliance, and when he says that he has used Messrs. Carson and Sons' paints for many years, and has found them easy to apply, useful and durable, I am convinced in my own mind that they are just what he describes them to be. I have never used them myself, and therefore cannot speak personally of their merits, but I shall take an early opportunity of trying and testing them. From the price lists which Messrs. Carson and Sons have sent me—and which in themselves are two handy lists for amateurs to possess, as they contain examples of the different colours that are manufactured by this firm, and the prices at which they are supplied—I find that two different descriptions of paints are made by them, namely, the Anti-Corrosive Paint for out-door use, and Non-poisonous Paint for application to interiors. The Anti-Corrosive Paint being for out-door use, is available for conservatories, damp walls, fronts of houses, and all iron work, and wood work in the open air. I lay some stress on this, because a short time ago I had a strong feeling in favour of *combined* stain and varnish for wood-work for out-door use. I have tried two kinds, and as the appearance of the woodwork to which they were applied is far from satisfactory after only six months' exposure, I shall give up their use entirely and stick to paint, and in all work in which I shall use stain and varnish I shall certainly stain first and varnish afterwards in the usual way. It will be useful to say that Messrs. Carson and Sons supply all articles requisite for painting and glazing, with varnishes, especially a black varnish for outside work, intended as a substitute for tar or as an outside coating where tar has been used, glass, wire netting, and Balmain's Luminous Paint, and the neutral base used as a kind of priming for this kind of paint. It is useless for me to attempt to give the prices of Messrs. Carson and Sons' Paints, beyond saying that they vary from 28s. to 50s. per cwt., according to colour. Prices of paints in small quantities are not stated, nor can I find, on looking through the price lists, than any prices are named for small quantities of colour, say even 7 lb. tins. It will be useful to add prices in small quantities, if Messrs. Carson and Sons wish to do business with those who buy on a small scale as well as with those who purchase largely. It would be a boon to amateurs if they did so, as it would save many of them from being nauseated, as I was the other day when trying some colour supplied at 5d. per pound, which had been mixed with some fish-oil, and which, in consequence, was most unpleasant to use. Amateur painters will have found that paint is apt to settle and become thick at the bottom when being used. This Messrs. Carson and Sons seek to obviate by a tin paint pot fitted inside with a mixer in the form of a tin plate perforated with holes, which can be occasionally moved backwards and forwards in the pot, keeping the paint in motion when it is in action, and thus preventing any settlement at the bottom of the pot. These paint pots cost 3s. each.

57. *Standring's Statistical India Rubber Table.*—Mr. Herbert Standring, publisher of the "India Rubber and Gutta Percha and Electrical Trades' Journal," has sent me a large sheet suitable for mounting on calico and rollers, after the manner of a map, which affords "A Statistical Statement from the Official Returns of the India Rubber, Caoutchouc, and Gutta Percha Trade of the United Kingdom of Great Britain (and Ireland !—why omit Ireland?) during the last Decade." The sheet may be obtained of Mr. Standring, 16, *Finsbury Street, London, E.C.* Mounted, with rollers, at 5s., and unmounted at 3s. To all who are in anyway interested in the India Rubber and Gutta Percha Trade, whether as importers, manufacturers, or dealers, this Table is most valuable, as it shows, clearly and plainly, printed in different colours for the sake of distinction, the imports and exports of raw and manufactured india rubber, or caoutchouc and gutta percha, to and from the chief parts of the United Kingdom and other parts of the world for the last ten years. By skilful arrangement it shows for each country in which these substances are articles of commerce the variations of this industry during those years where the trade has fallen off and requires an additional impetus, and where the opportunity of developing fresh business occurs. By the publication of this Table, which has been compiled by Mr. R. Rhens, 37, *Walbrook, London, E.C.*, Mr. Standring sets a good example for the exhibition of the imports and exports of other trades carried on in the United Kingdom, and it is to be hoped that specialists in them will not be slow to produce similar tables setting forth the progress and fluctuations of business in their own commodities.

58. *Zilles' Designs for Fret-work, Carving, etc.*—Mr. Henry Zilles, 14, *South Street, Finsbury, E.C.*, sends me some recent additions to his beautiful designs for fret-work, carving, marquetry, etc., etc. These comprise a great variety of articles all good in themselves, but of which the most noteworthy, perhaps, are a carved footstool in Gothic style, a very handsome birdcage in fret-work, a frame for a mirror, a table board, and clock face, for inlaying and painting, and a frame or case for mounting a barometer.

59. *Hardy's Self-Extinguishing Patent Benzoline Lamp.*—The perils to which we are subject from using benzoline as a source of light have been fully understood and recognized by Mr. William Hardy, Jun., *Thistleton, Oakham*, who has patented and introduced a lamp of ingenious construction,

which, if used in a proper manner, and in strict accordance with the directions given for filling it, will go very far to decrease them if it does not altogether avert them, as is claimed by Mr. Hardy. The lamp itself is made in the form of a globe about 3 inches in diameter, with a slight flat base about 1¼ inch in diameter, and a projecting equatorial rim, as I may call it, surrounding it at the junction of the hemispheres, which form the top and bottom of the ball-shaped lamp. On one side of the upper hemisphere is fixed a circular handle, and into the top screws the tube that holds the wick, and the rack by which it is raised or lowered as may be necessary. The interior of the lamp is much the same plan as the inner part of all benzoline lamps. On the tube which contains the wick is a free tube, held by a chain, and this tube, if the lamp is turned upside down, slips up over the light and extinguishes it. A cap to be kept over the wick when the lamp is not in use, to prevent the escape of the spirit, is also attached by a chain to the shaft, terminating in a milled head, which actuates the rack. Mr. Hardy claims that his lamp is superior to all benzoline lamps in the market by being unspillable, self-righting, and self-extinguishing. That it is self-extinguishing if accidentally thrown off a table or shelf by the rising of the free tube that is passed over the wick tube has been shown. It is declared to be unspillable by its resemblance to the ink bottles so called, but as I am not acquainted with these, I fail to see the point, especially as when properly filled no free oil is left in the lamp, and consequently there is nothing to spill. It is self-righting through the weighting of the bottom of the lower hemisphere, which causes the lamp instantly to recover its upright position if turned over. On testing the specimen before me, I find that I can *lay down* the lamp on its side in certain positions in which it does not recover itself, but I think this tendency may be obviated by abandoning the equatorial rim, as I have called it, and making the globe more truly spherical, and increasing the weight at the bottom. At the same time it must be allowed that the rim is helpful in preventing a complete overset of the lamp if it is knocked over by any accidental cause. The lamp, which is manufactured by Messrs. Snell and Brown, *Birmingham*, though trade terms, particulars and samples will be supplied by Mr. Hardy, the patentee, is neat and pretty in appearance and cheap enough, being sold at 1s. Persons visiting or resident in London can see them and buy them at Gardner & Sons, 453, *Strand, W.C.* Although I have subjected it to very severe tests, the only fault I can urge against it, is the non-recovery of its upright state when deliberately placed in certain positions, which in all probability it would seldom or perhaps never assume if let fall or turned over. I can safely say that it is the best lamp I have yet seen for burning benzoline, and I strongly advise all my readers who use benzoline to try one of Mr. Hardy's lamps.

60. *Noble's Expanding Mandrel.*—The Britannia Company, *Colchester*, ask me to call attention to Noble's Automatic Expanding Parallel Mandrel, which, although it is used in the works of many of our leading engineers and manufacturers and railway engineering works, as well as in the Woolwich Gun and Carriage Departments, has never yet been brought prominently before amateurs. It is stated to be "the most handy and economical engineer's lathe tool ever introduced," and an examination of the annexed illustration of the mandrel (see Fig. 2), partly in section, will go far to support the statement. The mandrel, A, is made of steel, with three grooves, into which are fitted three steel slides, F. At the end, D, the mandrel has a right-hand thread, and at the end, E, a left-hand thread. The tightening nut, B, is also the driver, and as the tool comes in contact with the work it moves the driving-nut and the three slides up the mandrel, which thus expands exactly sufficiently to hold the article firmly. The advantages offered by this mandrel are as follows:—(1.) Any article, such as pulleys, brushes, etc., can be fitted by it in a moment without fixing in a vice or hammering. (2.) The slides expand automatically; the deeper the cut of the tool, the tighter the mandrel holds, as the driver is also the tightening-nut. (3.) The slides always expand parallel to centres, thus assuring true work, which cannot be done on the old style of mandrels, which are slightly tapering. (4.) By the saving of time effected by the use of these mandrels, their first cost will be repaid in a comparatively short time. Each mandrel expands from ¼ inch to ⅜ inch, according to size, and extra slides can be supplied at a small extra cost, a shown below, to expand to double or treble the sizes given; furthermore, the extra slides provide for intermediate sizes. By unscrewing the nut C with a spanner, the tightening nut B will unscrew at the same time, the former having a left-hand thread and the latter a right-hand thread. The sizes and prices of mandrels kept in stock are as given below, but for special work they can be made to order to any size:—

No.	Inches.	Cost.	Extra Slides.
1	To take 1¼ to 1 5/16	35s.	15s.
2	,, 1⅝ to 1⅞	35s.	12s.
3	,, 2 to 2¼	45s.	12s.
4	,, 2⅜ to 2⅝	55s.	15s.
5	,, 3 to 3⅜	75s.	15s.
6	,, 3½ to 4	85s.	16s.
7	,, 4⅛ to 4⅝	100s.	17s.
8	,, 4¾ to 5½	110s.	17s.

61. *Winn's Improved Malleable Self-Centring Vice.*—Amateurs who want to supply themselves with any special screwing and drilling tackle will do well to consult the Catalogue and Price List, Section B, of Messrs. Charles Winn and Co., General Metal Workers and Mechanical Engineers, *St. Thomas's Works, Granville Street, Birmingham*, who supply many articles suitable for amateurs, at moderate prices, such as the Cheap Bench Drilling Machine, to which reference has been made by Mr. George Edwinson in his paper on "Smithing and Forging." Among the articles named in this catalogue, I may call attention to Winn's Improved Malleable Self-Centring Vices, for machine use, and which form suitable appendages to drilling machinery. The form of the vice is clearly shown in Fig. 3, from which its manner of action may also be understood. The vices are made of malleable iron entirely, and therefore combine strength with lightness; the screws are of the best steel, and the jaws machine-cut and case-hardened. When required to hold any work needing holes drilled in its centre,

the loose turned shank shown to the right of the figure is dropped into the central hole of the machine table, and the vice placed upon it, when, by means of the right and left-hand screw of the vice, such work will be gripped, so that its exact centre will be under the drill point. When required for holding work to be drilled out of centre, if the shank be removed, the vice may be used in the ordinary way. The dimensions in which these self-centring vices are made, and their prices, are as follows:—

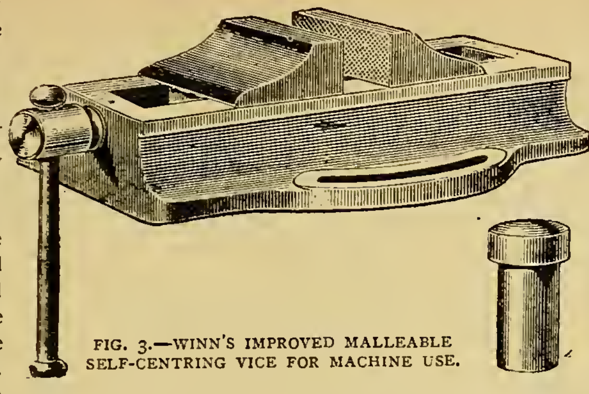


FIG. 3.—WINN'S IMPROVED MALLEABLE SELF-CENTRING VICE FOR MACHINE USE.

No.	To suit Machine Drilling up to	Width across Jaws.	Width of Opening.	Price.
1 ...	$\frac{3}{4}$ inch diameter. ...	3 inches. ...	4 inches. ..	27s. 6d.
2 ...	1 ,,	... $3\frac{1}{4}$,,	... 5 ,,	... 40s. 0d.
3 ...	$1\frac{1}{4}$,,	... $3\frac{1}{2}$,,	... 6 ,,	... 50s. 0d.

Considering the great utility of these vices, the prices asked for them are very moderate.

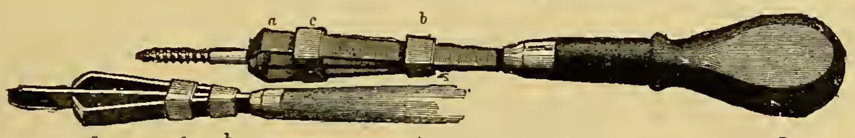


FIG. 1.—KOLB'S COMMON SENSE SCREWDRIVER.

62. *Kolb's Common Sense Screwdriver.*—Messrs. Charles Churchill and Co., 21, *Cross Street, Finsbury, London, E.C.*, have recently added this clever invention to their stock of American tools, and have sent me a specimen for testing. The form of the screwdriver is shown in Fig. 1, in which it is represented at A with the sliding part pushed down to the handle, and at B as holding a screw, all ready for driving. It is claimed for this screwdriver that when screws are driven by it, it is unnecessary to make any hole in the wood with either bradawl or gimlet for its reception, that it is impossible for either screw or driver to slip, and that the work of drawing in the screw is quick and easy. The directions for use are as follows: — To put a screw on to this driver without losing time, first push the jaws (*a*) back towards the handle, so that you can see the driver properly and in the position shown at A. Take a tight hold of the handle, the thumb and first finger on the sleeve (*b*), to which the jaws are fastened, not the loose sleeve (*c*). Insert the driver into the slot of the screw, now slide the jaws forward, and when they come to a stop, which they will do by the sleeve *b* coming in contact with the upper part of the blade of the driver, which is broader than the lower part, push forward the loose sleeve *c*, which will tighten the jaws around the screw. This can be done very quickly after a few trials. You are now ready to start and drive a screw anywhere with one hand, the other may hold the work. When the screw is driven nearly in, push the jaws back again without stopping while driving, and, without allowing the driver to get out of the slot, drive home. In taking out a screw first loosen it with a few turns of the driver, push the jaws forward, tighten up and take it out. While drawing a screw do not press against it as with an ordinary driver; the pressing does not help it—a screw when turned will draw itself in. The Common Sense Screwdriver is an ingenious, though simple invention, easy used, and invaluable when dealing with small screws. When countersinking is required this can easily be done before the screw is driven into the wood. The screwdriver will, I think, soon find its way into favour among amateurs. Its price is 2s. I do not know if it is made in different sizes, but for the information of my readers I may say that the screwdriver before me is $9\frac{1}{4}$ inches in length, the blade of the driver $4\frac{1}{4}$ inches long, and the sliding jaws very nearly 3 inches long. The instrument is well made and finished, and is furnished with an ebonized handle.

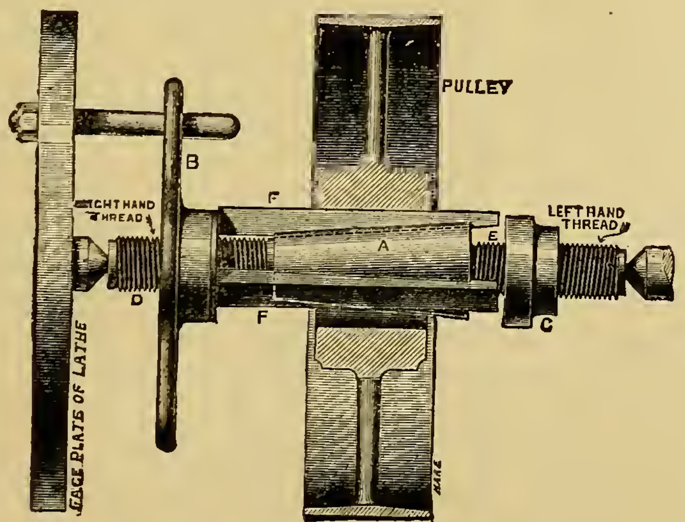


FIG. 2.—NOBLE'S EXPANDING AUTOMATIC MANDREL.

AMATEURS IN COUNCIL.

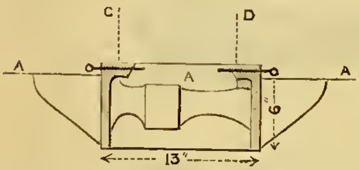
**** For Instructions to Correspondents, see page 44 of this Volume.*

Model Engine Making.

STADT DRESDEN writes:—"Mr. Pocock, in his first article on Model Engine Making, says, 'We must, in the outset, admit that model engines cannot be exactly like their larger prototypes, for a small engine made precisely to scale would not in itself be well proportioned.' Now this seems to me a most extraordinary statement, still, as English practice may differ from German, I should like to hear more about it. Here, unless an exact and precise miniature is made, one would be only throwing away time and material. I have always understood that the best models are those copied precisely from a full-sized engine, and therefore, I have generally proportioned mine from a Molesworth's pocket book, but still the plan may be open to objection."

Pattern for Planing Machine Bed.

STADT DRESDEN.—In answer to your inquiry I must say that it will be a little awkward to mould centre with core box,



CORE BOX FOR BED OF PLANING MACHINE, WITH PATTERN IN POSITION.

but I submit a plan whereby it could be done. My plan is to mould it into two half boxes, as shown in illustration. Along A A the joint of the mould, I take B to be a detached piece, if not, it will require doing as shown at C and D, that part of pattern being loose and secured in place by screws, as shown, the rest explains itself. After moulding, turn box over to cast; by so doing you will get a good face on the planed surfaces, as I take for granted the top is to be planed.—A. J. S.

Norwegian Gimlets.

W. B. (*Oxford Street, W.*)—If you had asked for information beyond that which had appeared on this subject in "The English Mechanic," the correspondents who wrote in response to your query would not have troubled you with a twice-told tale. It does not follow that all readers of AMATEUR WORK read "The English Mechanic" also, like yourself, and to many of them, the facts contained in the replies which your inquiry elicited, were undoubtedly new. A little consideration will show you that queries are answered in this magazine as speedily and promptly as the working of a monthly serial will permit. A fortnightly supplement, at 2d., with Notes on Novelties, Amateurs in Council, and Advertisements, in addition to what appears in the monthly part, is not practicable. Most readers, I think, would not buy the supplement, and thus might miss replies to their queries. No change whatever is contemplated at present—either in the form of the Magazine or its issue as a monthly periodical.

Removal of Grease from Paper.

F. T. (*Stanmore*).—Refer to AMATEUR WORK, Vol. III., p. 371 (Part 31, June, 1884) and you will find the recipe you require for the removal of grease and oil from your books. I would add: If you use spirit of wine, let it be of as high a strength over proof as you can procure. This is effective when petroleum spirit fails.—B.

Steel-facing Dies.

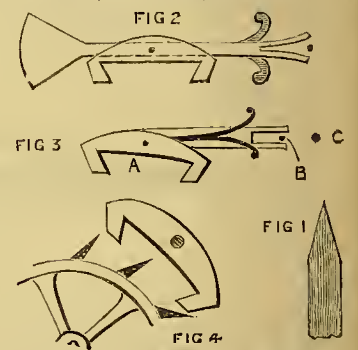
G. R. R. (*Antwerp*).—I do not know the behaviour of nickel deposits on dies made of copper, but should think the dies could not be so durable as those made of steel. Electrotypes for printing are sometimes subjected to a process termed "steel facing," to make them more durable. A thin coating of iron is electro-deposited on the face of the electrotype, and this coat is almost as hard as steel. The solution employed is that of the double chloride of iron and ammonia worked with current from a three-cell Bunsen battery. If nickel is substituted, it should be deposited by a similar battery from the double sulphate of nickel and ammonia solution. "Steel-faced" electros would rank first, next to steel itself for hardness; then nickel, and, lastly, copper. I cannot speak respecting the effect likely to be produced by jarring on the "faced" die, but suspect it would tend to injure the deposit.—G. E. [This Magazine will be sent to you, post free to Antwerp, for 7s. per annum, this being the amount of subscription for one year, commencing at any time. All back parts are in print, and can be had.—ED.]

Graining Machine.

W. B. (*Whitehouse*).—Although you attribute delay in answering your former questions to a non-compliance of rules on your part, I do not remember receiving any previous communication from you on the subject. The Graining Machine, mentioned by Mr. Edwinson in his articles on House-painting, etc., is known as "Bellamy's Graining Machine." The prices are: 3 inch, 16s.; 4 inch, 18s.; 5 inch, 22s.; 6 inch, 26s.; 7 inch, 30s.; 8 inch, 37s. They are sold wholesale at the above prices by Messrs. Hamilton and Co., 9 and 10 *Greek Street, Soho Square, London, W.*, or may be obtained through a local dealer.—G. E.

Cleaning and Repairing Timepiece.

T. S. (*Wolverhampton*).—You do not say whether it is a new balance and hair spring you wish to put, or merely the same back in its place; also, whether it is an American or English lever timepiece; however, I will suppose it is an American and you have taken it out to clean. If so, first thoroughly clean out the holes in the two screws (one in each plate) the balance staff works on. You can do this by cutting a piece of peg wood to a long bevel, as shown in Fig. 1, and turning it backwards and forwards till you see the bottom of the hole nice and bright; then see next that the ends of the staff are not worn at all; if they are (as they will sometimes if not kept oiled), you must let down the temper, and file them up to a long bevel and as sharp as a needle; then re-temper by making red hot and plunging in oil. Then to put in position, screw in the screw with the regulator and collet on till quite tight. Take up the balance and put one pivot in, seeing that you have the hair spring nearest to the regulator side, and put in the other screw a little way; then before screwing up tight, see that the pin that works in the lever on the pallets is in the notch. Sometimes the lever has four small arms at end, as in Fig. 2, and the pin must be where the dot is, between the two middle ones. To put properly in beat, pass the end of the spring through the loop in the regulator and then through the hole or slot in the stud fixed to the plate, drawing the spring through so far, that when looking from the back of the balance at the pallet staff, the pin in the lever shall make a straight line with the balance staff and pallet staff, as in Fig. 3, A pallet staff; C, balance staff; B, pin on balance (called in watches the ruby pin), and on looking from C to A you must only see as much of the



CLEANING AND REPAIRING TIMEPIECE.

Fig. 1.—Bevelled Wood for Cleaning Holes. Fig. 2.—Lever with four arms at end. Fig. 3.—Position of Parts on putting in Spring. Fig. 4.—Connection of Scape Wheels and Pallets.

lever one side as on the other; by drawing in or letting out the spring you can adjust it exactly. Now turn balance round (after screwing in the second screw till the balance staff has only the slightest endshake) till the pin is right at the back away from the lever, and see that the lever has freedom from the staff. Try both sides, if one side has more than the other, bend the lever a little till both are equal; now see that the scape wheel works on the pallets properly; watch the scape wheel drop on the pallet and see that it falls just about the thickness of the tooth on the straight side of pallet, as in Fig. 4. It must not fall too far, or else the tops of teeth will touch the inside of pallets; now oil both pivots of balance staff and all other pivots, and a drop on each pallet. If you do not succeed, or there is any other difficulty, write again.—A. B. C.

Protractor and Sector.

W. G. B.—I have asked OLLA PODRIDA to furnish a paper giving you the explanation you personally require on the use of the protractor and sector, for I am persuaded it will be of use to other amateurs besides yourself.

Glass Vases for Fretwork Epergne.

A. E. P. (*Hull*). In reply to your question I obtained my glasses for the Epergne in fretwork, at Messrs. Davenport, Glass Manufacturers, *Longport, Stoke-upon-Trent*. I only had four glasses for the arms (pea green colour) and a ruby glass for the top vase, and they cost me about 3s. If A. E. P. wishes, I will obtain the glasses for him, and simply charge the carriage to him in addition to Davenport's charges, as the glass works are within a mile of here. Of course, he must send me the exact size.

Wood's "A Photograph, and How to Take It."

B. S. (*South Hampstead*) writes:—"In your 'Notes on Novelties,' Vol. V., page 426, you say you believe 'A Photograph, and How to Take It,' costs 1s. I thought you might be interested to know that Mr. E. G. Wood gives this work away gratis." [Mr. E. G. Wood is very generous to the public: that is all I can say. I estimated the probable cost partly from the size and partly from the value of the information given in the work.—Ed.]

Colouring Photos on Back.

H. S.—I have never found any difficulty in getting a bright appearance if the subject required it and the photograph was suitable. Several causes may combine to give the dingy look H. S. complains of, such as the use of dull colours, deficiency in high lights on the photograph, insufficient use of white in mixing the paints. This latter is a frequent mistake with beginners. Lack of transparency in the photograph, or rather in the paper, also causes the colours to appear dull. If the finished painting is intended to have a bright appearance, as much as possible of the paper should be rubbed away; but if the subject is one that does not require bright colouring, less paper may be removed; as for example, one the Editor has of a monk in a cellar. A bright background would naturally be out of place, consequently hardly any of the paper was removed. If H. S. still can't succeed in getting the effect he wishes, and he will send a painting with the paint on the back not covered, so that I can see the exact tints he has used, I shall be happy to explain as far as I can the cause of failure.—D. A.

Carson's Anti-Corrosive Paint.

J. C. (*Burton Fleming*) writes:—"As one of the constant readers of this periodical, and encouraged by your courtesy on former occasions, may I venture to draw your attention to the fact that I have lately been using some paint manufactured by Carson and Sons, *La Belle Sauvage Yard, Ludgate Hill, E.C.*, with great success. Being very easy to manage and economical in use, it does not require skilled labour to put it on. And being also supplied in small quantities, I am quite of opinion that you would confer a benefit on your readers generally if you were pleased to mention the firm and their productions under "Notes on Novelties," so soon as may be suited to your convenience. Let me add that I have used *Carson's paint* from *time to time* over *a period* of *ten years*, and the results are all one could wish."

Donkey for Marquetry and Fret Cutters.

Twist Drill writes:—"I wish to thank A. Sinus (page 396) for his design of an improved donkey. The adjustable jaws are a great improvement, but I think that the upright with hinged arm, about 6 inches long, is more convenient than a simple straight arm (E, Fig. 1, page 397) hinged to the bench, as allowing the workman to sit up closer to the jaws, and it is more convenient to have the treadle at right angles to the beat than parallel to it. Another method is to have a heavy weight to close the jaws and an oval eccentric between them, worked by the foot, to open them."

Painting Dog Cart.

W. L. (*Golborne*).—Before I can answer your query about painting the dog cart, I must first ask for more information than you give me in your letter. (1) Is the dog cart in question one you have painted, and, when finished, the result has proved unsatisfactory? or, is it another that you wish to paint? (2) You say you bought the best paint. Was it ready mixed, or was it powder colour, and did you mix it yourself; and, if so, how did you mix it? (3) You do not say if the panels of the sides and back of dog cart are cracked or smooth, so I do not know whether they want flatting down with pumice-stone or filling with patent stopping and flatting down afterwards. If you have painted it with this colour you have bought, and it was composed of boiled oil and dryers, the paint will all have to be scraped off again. (4) Are the shafts fastened underneath the body of the trap, or are they fastened at the sides? If at the sides, they will have to come off, as we should not be able to get to the panels. (5) How have you painted the cart? The wheels, springs and shafts only should be in colour, the body painted with best Japan and fine lined. Kindly let me know all particulars—what colour you are going to paint it and the colour you wish for fine lining; also, what sort of lining—whether broad with fine lines, or fine lines only, and I then shall be able to put you more in the right way of painting your dog cart. Do not scrape off the paint or work at the dog cart until you have told me the particulars, and then I will set you right.—W. P.

Le Page's Carriage Glue.

H. S.—Le Page's Carriage Glue is to be obtained of Messrs. Richards, Terry and Co., 46, *Holborn Viaduct, London, E.C.*, sole agents for the United Kingdom, the British Colonies, and the Continent of Europe.

Photographic Matters.

T. J. O'C. (*Dundalk*).—1. You ask if the potash sols. given, I presume, in Chapter V., "Dry-Plate Photography," may be used after keeping for a length of time. The potash (B) solution will, of course, keep good an indefinite period; but the pyro (A) solution will quickly discolour from oxidation, if exposed to the air, or if placed in contact with some organic agent, such as dirt or the impurities contained in water. This solution, then, must be preserved in a bottle with a tightly-fitting stopper, and distilled water *only* used. The sulphurous acid is used to prevent the solution's oxidation. Nitric acid might be substituted, but whereas the latter acts also as a *restrainer* to the action of the developer, the sulphurous acid has not this effect. I may say that I am now (8th July) using solutions which were made up a week or two after Christmas, and although the pyro sol. is somewhat discoloured, it has not, as far as I can see, deteriorated in its action in any way. I often use a 10 per cent. sol. of bromide, which I find very useful for over-exposed plates. From 1 to 4 drops being added for a half-plate. 2. Although some people say the clearing sol. given in page 414 should not be used more than twice or three times, I find it may be used again and again for at least a fortnight. 3. If you will refer to the note at the foot of page 411 you will see that the Apothecaries' weights only should be used; unfortunately the chemist uses the Avoirdupois weights, and this fact is often the cause of many mistakes being made in making up solutions. Thus an ounce of pyrogallic acid, when used for making up a solution, is supposed to contain 480 grains, but if used as sent from the chemist it will contain only 437·5 grains, or 42½ grains less than the formulæ requires. It is for this reason I have calculated my formulæ to an Avoirdupois ounce of pyro., as supplied from the dealers. Again, while a "Photographic" pound is composed of twelve ounces, a "Commercial" pound contains sixteen. It would be better, I consider, if the French decimal system could be universally adopted in England and other countries, as our present system is far from perfect and very misleading.—C. C. V.

Overglaze Painting on Porcelain.

D. J. B. (*Brixton*).—You are right in what you say respecting the numbering of chapters in "Overglaze Painting on Porcelain," namely, that "in Part 44, Chapter XII. should be printed XIII., and in Part 53, Chapter XIII. should be printed XIV. both in text and on cover." There is yet one more paper to come, but as I am not a prophet—in the foretelling sense of the word, at all events—I cannot tell you when it will come to hand. The writer of the papers is not treating either the readers of the Magazine or himself well in neglecting to complete his contract, and in allowing so many months to elapse between the appearance of the concluding chapters, and he owes an apology to the former for not having long since brought his papers to an end.

Illuminating and Missal Writing.

D. J. B. (*Brixton*).—Your request on this subject shall be noted and considered.

Editor's Address.

D. J. B. (*Brixton*).—I have said several times in Amateurs in Council that my address is simply "*The Editor of* Amateur Work, *c/o Messrs. Ward, Lock and Co., Warwick House, Salisbury Square, London, E.C.*"

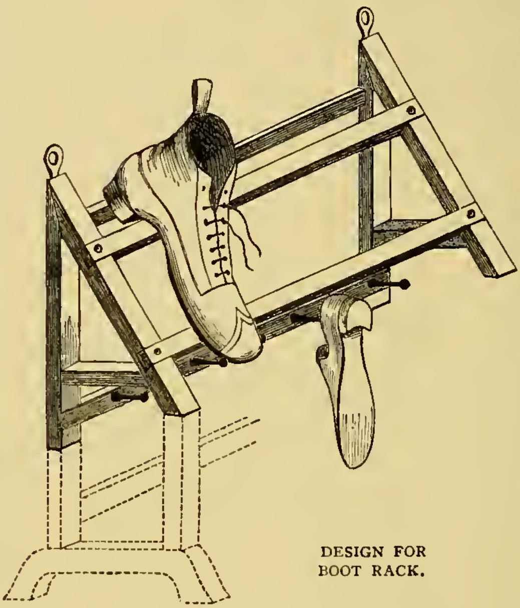
INFORMATION SUPPLIED.

Norwegian Gimlets.

Mr. Fred. Carre writes:—"In the great *ice age* through which we are passing, the few days of our short summer have to be made the most of, therefore I have only had a cursory look over your last two numbers, and did not see, till a few days ago, that a correspondent made some enquiries about the Norwegian gimlets, in reply to which you have given my letter from the 'English Mechanic' of February last. I have only to say in addition to what I wrote then, that the illustration given by me gives a very correct idea of the tool, and placed side by side with the illustration given by you of the French gimlet, shows it as quite distinct, and Montmartre mistaken in supposing they were similar. I have both kinds, the French is not bad, but it cannot be compared to the Norwegian in the points I have spoken of. It would appear from your correspondent's investigations that the real Norwegian tool cannot be got at present in England. I believe it would pay for some dealer to import them, as they are much cheaper than those of similar size of English make. I paid 20 to 40 ore for sizes from ⅛ in. to ⅜ in., which would be about 2d. to 5d. I see some one in your July number recommends getting them made by a good tool maker, as he found them to break off at handle. I can only say I think this writer cannot have come across the genuine articls. I have proved them in every way, and though the steel is not the best, it certainly has not acted as stated, and though soft, it serves its purpose well. I would also warn anyone inclined to take the advice, to apply to a good tool maker, that he is by no means sure to get what he wants, and if he does it will, I would expect, be at about double or triple the cost. The tool, though simple, is not so easily made without practice. I have made them myself, but at a cost of time—for the few—that would have made them very dear, had it to be paid for, at much below first-class workman's wages. The forging of them is simple enough, but the filing or grinding up, so as to give just enough of *conicality to the spiral*, is not attained without more practice than the making of a few will give. And it is wonderful what a difference even a slight error in the *point* of the spiral, or the amount of its conicality, will make in the satisfactory working of the tool. I cannot close without bearing my testimony to the general usefulness of your Magazine, to which I have been a subscriber from the first. I have been particularly pleased with Mr. Gleeson White's articles, and his original and *excellent designs*, which are unique in every way. The thanks of the whole body of our amateurs are due to him. I am very glad to see you purpose taking up Repoussé work, and hope the articles will soon appear [They will be commenced in the November Part.—Ed.], and that the illustrations of tools will be clear, and, if possible, full size. Any handy man should be able to make them. It is exorbitant to charge 1s. each for such simple tools as tracers, which I see is the list price of Gawthorp and the other man you mention. Could you give us a set of articles on Basket-making?" [I will, as soon as I can meet with a man who can make baskets, and describe the mode of making them.—Ed.]

Boot Rack.

L. S. D. (*Jamaica*) writes in reply to Bags:—"I notice in Vol. IV., page 336, that Bags wishes for a design for a boot rack, and you refer him to one given in Vol. II., page 513. I send you herewith a sketch of one I have made for myself,



DESIGN FOR BOOT RACK.

which, I find answers the purpose very well and is very easy to make; in fact, the construction is so simple that it needs little or no instruction, the sketch being, I trust, sufficient. The enclosed design is for one to hang against the wall, but it can be made to stand on the floor by lengthening the legs, as shown by the dotted lines. The length and dimensions of material must depend on the number of pairs of boots it is meant to carry, and can be readily ascertained by measuring the width of each boot and allowing an inch or an inch and a half between each. I made mine of wood three-quarters of an inch square (the rails a little wider), and it carries five pairs of boots, besides shoes and slippers, on the pins below. If it is meant to take to pieces, the rails must be halved and notched into the side-pieces, and fixed by means of screws; but if intended for a permanent structure they should be mortised or glued, which, of course, adds to its strength. If Bags requires any further hints, I shall be glad to supply them.

INFORMATION SOUGHT.

Cutting Large Looking Glass.

E. W. writes:—"I have a large looking glass, and I want to cut it across to make two of it. Could any reader of Amateur Work inform me how to go to work about it? The glass is about 36 inches wide."

Lallande-Spence Primary Battery.

Euripides writes:—"I notice in page 439 of this volume that Racavar has kindly offered to supply particulars of any simple battery, with your permission, through the medium of "Amateurs in Council." If Racavar would give me a few hints toward the completion of a small instalment of the Lallande-Spence Primary Battery, which I have partly finished, I would be very much obliged. The battery, as he is probably aware, consists of iron trough-shaped cells piled on top of one another and insulated, the elements being caustic soda, zinc, and oxide of copper. I have got the cells cast, and also the zinc plates, but have had to stop short at the insulators, which would want to be of a peculiar shape, as they have to serve the double purpose of supporting the zinc plates in suspension about one inch from the bottom of cell, and insulating the cells from one another. I have tried a good many firms, but they have nothing to answer the purpose, and would charge a good deal to produce such an one; but if he can suggest anything to fulfil the same conditions, it will do me just as well, as appearance does not matter. Then, as to materials for working the battery, I have priced caustic soda over here, and the only kind sold costs 6d. per oz., whereas, I have been told that it can be had at about 1d. per lb. in Lancashire, where it is manufactured; the oxide of copper is also very dear, costing 2s. 8d. per lb. here; and as a considerable quantity of both are used, the prices are prohibitory to anyone with limited means.

Paper for Mounting Photographs.

Only an Amateur writes:—"There is a coloured paper, with a surface resembling cloth or velvet, used for mounting photos. or pictures. Can any brother amateur tell me if I can produce such a surface on paper myself, and how, if not, where can I purchase the paper? I have tried all the principal paper stores in this district (*i.e.*, Sunderland), but cannot get it."

Change of Address.

Mr. Henry Zilles desires me to notify to readers of Amateur Work that he has removed to 9, *South Street, Finsbury, E.C.*, and that all communications and orders should be so addressed.

LETTERS RECEIVED UP TO AUG. 11.

[*Replies to these in Next Part.*]

H. H. (*Canterbury*); J. G.; Clyde; St. Crispin; Twist Drill; W. G. B.; A Wanderer; Flashing Dynamo; E. W. A.; E. C. F. (*Halifax*); Barking Road; True Blue; C. H. (*Oxford*); Paheka.

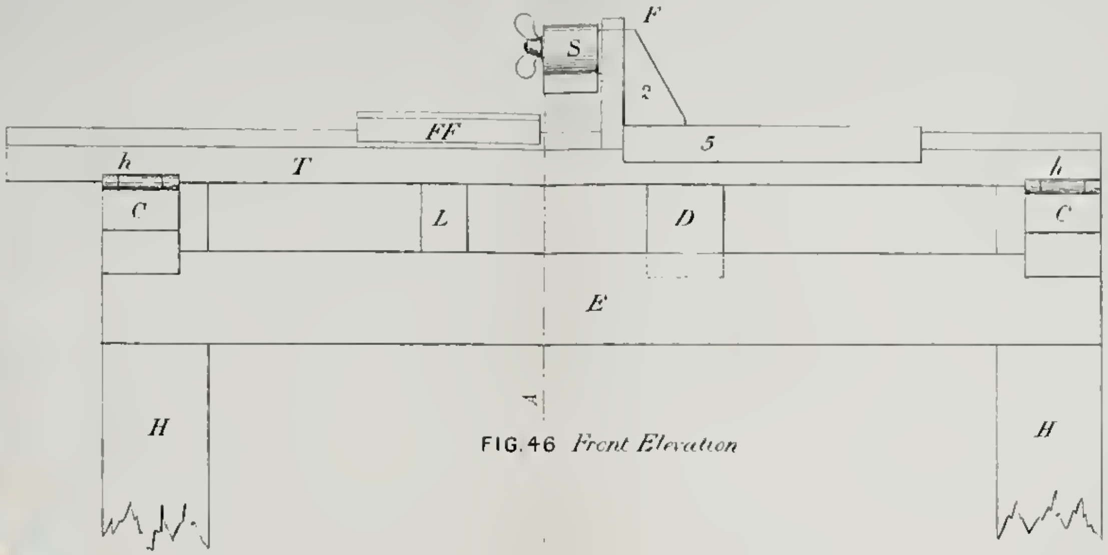


FIG. 46 *Front Elevation*

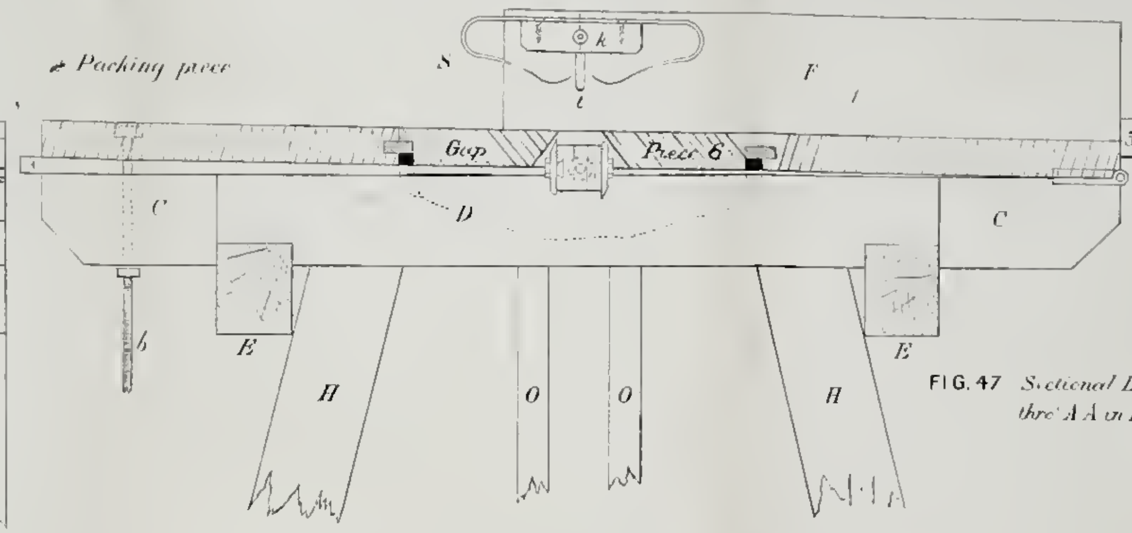


FIG. 47 *Sectional End Elevation thro' A A in Figs 46 & 48*

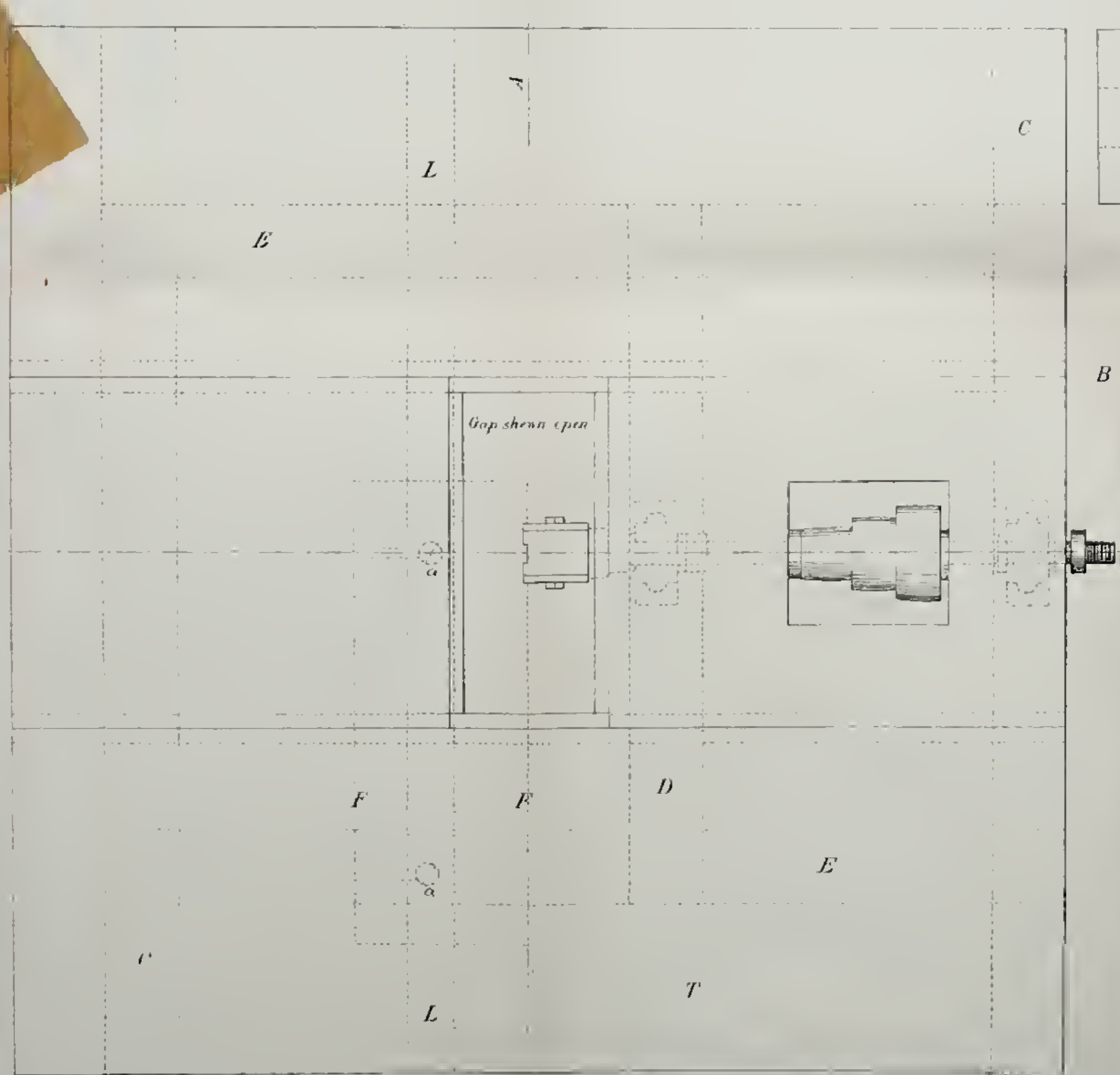


FIG 48 *Plan*

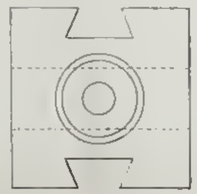


FIG 49.

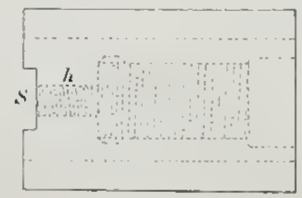


FIG 49^a *Cutter Block*

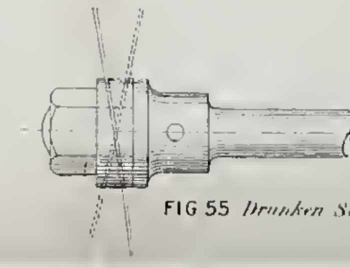


FIG 55 *Drunken Saw*

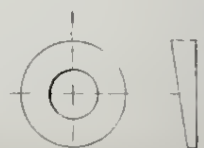


FIG. 54 *Washers for do 2 in No.*

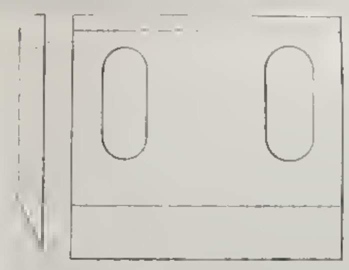


FIG. 50 *Cutter*

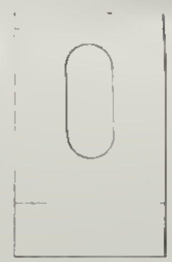


FIG 50^a

FIG 54 *Gap Piece*

FIG. 54^a

FIG 51 *Bolts for Cutters*

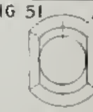


FIG. 51^a

FIG. 53 *Block for Spring*

FIG. 53^a

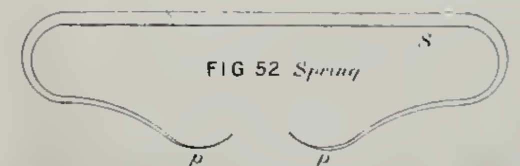


FIG 52 *Spring*

FIG. 52^a

NOTE Figs 46, 47, 48, 54 & 54^a are drawn one fourth full size
Figs 52, 52^a, 53, 53^a, 55 & 56 drawn half size
Figs 49, 49^a, 50, 50^a, 51, & 51^a full size

Arrangement of Planing Attachment for CIRCULAR SAW BENCH,

WITH DETAILS OF GEAR FOR PLANING, GROOVING, AND REBATING.

Designed specially for AMATEUR WORK by

OLLA PODRIDA.

(See large Folding Sheet with Part 54)

UNWIN BROTHERS LONDON, E.C.

FERROTYPING FOR AMATEURS.

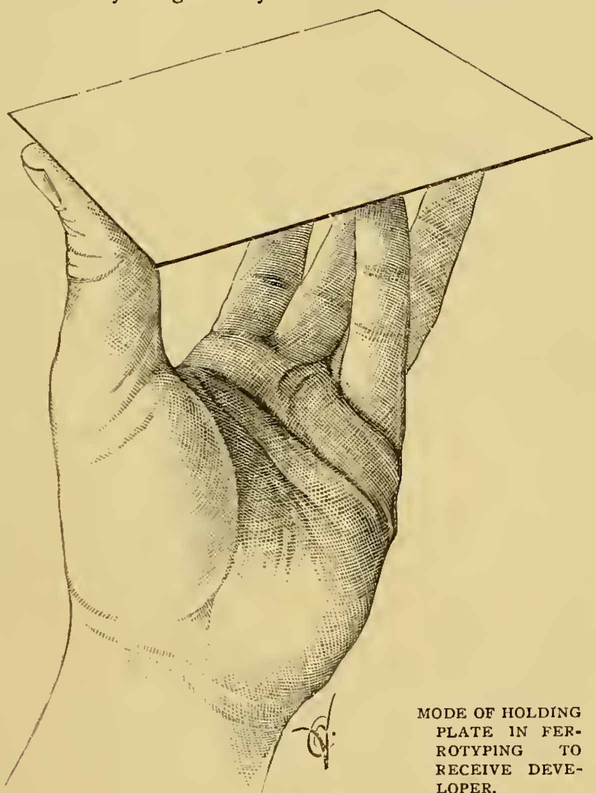
By C. C. VEVERS.

IT is a matter of no small wonderment to me that so few amateurs, and those of an experimental tendency especially, venture to work and learn something of the wet process in general and ferrotypes in particular. The reason of this, however, has not far to be looked for. During the last four or five years the disadvantages of the wet-plate process and the advantages to be derived by using the dry-plate method, have been constantly dinned into the amateur photographer's ears, and the consequence is that few amateurs dare approach this demon dirt and mess in disguise. Most unquestionably the collodion process shows its disadvantages when compared with the gelatino-bromide process, the principal of these being the slowness of the plates produced and the dirt and mess which arises from their manipulation; but the latter has, I think, been latterly much exaggerated, and these detriments are in my opinion, fully outweighed when the ease with which the plates are managed and the short time required to finish a positive picture, are placed in the other end of the scale.

I propose, in this short paper, to treat only upon the ferrotype process—to describe fully the various operations required for producing a satisfactory tin positive, to give reliable formula for making up the solutions—bath, developer, and fixing—and append the average prices of both chemicals and materials used. The method of making a glass positive is almost exactly analogous to that for tintypes, with the exception that a glass plate takes the place of the thin piece of metal and afterwards has to be backed with a black varnish to render it opaque; consequently, the following directions can be applied to glass as well as tinplates, although the latter are, perhaps, easier to work, and are therefore to be recommended.

The materials and solutions required in addition to the amateur dry-plate photographer's usual stock are comparatively few and cheap, and are easily managed. The subjoined list shows all that are required, with quantities attached sufficient to commence operations, and the prices of each taken from a well-known dealer's catalogue:

	s.	*d.*
5 ozs. Mawson's Positive Collodion	1	9
1 oz. Recrystallized Nitrate of Silver	3	4
½ oz. Potassium Iodide	0	7
1 oz. Pure Nitric Acid	0	2
Distilled Water.		
1 lb. Protosulphate of Iron	0	2
1 oz. Nitrate of Potash	0	1½
2 ozs. Glacial Acetic Acid	0	4
1 oz. Cyanide of Potassium (in sticks)	0	2
Porcelain Vertical Bath and Dipper	2	3
4 doz. Ferrotype Plates	2	3
1 doz. Sets of Mats, Preserves and Trays	1	9



MODE OF HOLDING PLATE IN FERROTYPING TO RECEIVE DEVELOPER.

In the above list the prices quoted are for quarter-plate size, as that size will fit the amateur's carriers; a very popular size for ferrotypes, however, is what is known as one-sixth plate, or 3¼ by 2¾ inches, the prices for this size, of course, being somewhat lower than for the former.

Mawson's positive collodion is supplied in bottles iodized and ready for use. For portraiture and work requiring a rapid exposure new collodion should be used, but for landscapes collodion several months old may, with advantage, be employed, as it yields a better picture; but as the collodion ages it turns red, and, at the same time, loses much of its sensitiveness; for example, a plate coated with a freshly-prepared collodion requires an exposure of, say, ten seconds; but when developed, the image will appear somewhat thin and weak, while under exactly similar circumstances, the plate coated with a two or three months old collodion should have from twelve to fourteen seconds' exposure, but the resulting picture will be more brilliant than in the former case.

The silver nitrate should be obtained *recrystallized.* A cheaper and more impure quality is sold at about 3s., but should not on any account be used.

A "dipping," or vertical bath for the silver solution is absolutely essential, as an open horizontal tray would be productive of innumerable defects from dust and the like.

A crystal varnish is supplied specially prepared for protecting the positive film, but the ordinary negative varnish will be found to answer the purpose equally well.

The ferrotype plate may be obtained ready cut to size or in sheets measuring 14 by 10 inches. They are coated with either black or chocolate varnish; the latter colour is to be preferred, as it produces the most pleasing effect for the shadows of the image.

The following solutions must be prepared, the chemicals must be carefully weighed and measured, and afterwards placed in clean stoppered bottles. If the vertical bath be supplied with a cover or lid the sensitizing solution may be permanently kept therein, but in any case it must be carefully guarded against dirt or dust.

The silver solution should be somewhat stronger than for negatives; one composed of 40 grains of silver nitrate to each ounce of water will be found to yield the most satisfactory results. The following formula makes a useful little bath:

Silver Bath.

Nitrate of Silver	1 oz. (avoirdupois)
Distilled Water	11 ozs.
Iodide of Potassium	3 grains
Nitric Acid, if required.	

Into the distilled water (which must not be in the slightest degree acid) dissolve about twenty or thirty grains—the exact quantity is immaterial—of silver nitrate. This solution, in a white stoppered bottle, is placed in the sun or broad daylight until the dirty red colour it will assume has gradually cleared away, leaving the solution perfectly colourless. Any dirt before contained in the solution will now be precipitated to the bottom of the bottle and must be carefully filtered away, and the rest of the silver and potassium iodide then added; the solution will probably turn milky and must be refiltered. For use, the bath should be very *slightly* acid; test with blue litmus paper, and if the solution is neutral or alkaline add dilute nitric acid, drop by drop, until the litmus paper *slowly* reddens; this operation should be conducted with great nicety, as an alkaline or very acid bath is productive of fog and many other defects.

Developer.

Protosulphate of Iron	$1\frac{1}{4}$ ozs.
Glacial Acetic Acid	$1\frac{1}{4}$ „
Alcohol	about 1 oz.
Water	20 ozs.

First dissolve the iron in the water, then add the acetic acid and alcohol, which is used to make the developer flow easily over the plate, and may be modified to suit circumstances. This developer, although so very simple, will be found to produce the best results on ferrotypes. Some operators use a developer for positives containing nitrate of potash, and made thus: Iron, 1 oz.; nitrate of potash, 2 drachms; acetic acid, 4 drachms; nitric acid, 5 minims; water, 1 pint, and alcohol as required.

Fixing Solution.

Cyanide of Potassium	100 grains.
Water	10 ozs.

The bottle containing this solution should be distinctly labelled POISON, and should always be handled with great care, as the cyanide acts upon cuts or scratches on the skin, forming very sore and sometimes dangerous places. If preferred, hyposulphite of soda, although not so satisfactory, may be substituted, the fixing bath being a saturated solution of hypo in water.

When all the materials have been obtained and solutions prepared as directed, the amateur can at any time proceed to work. It is advisable to clean and coat the plate in a room entirely free from dust if possible, as nothing is more conducive of pinholes and opaque spots than a dusty room, and dust cannot be brushed off a moist film as it can from a dry-plate. A plate is taken from the box, the best side selected and carefully polished with a clean cotton cloth; if glass be used in place of the tin plate, it should be first well cleaned with the following solution, and afterwards polished:—

Iodine	15 grains.
Tripoli	1 oz.
Methylated Alcohol	5 ozs.

The plate is next coated with collodion in exactly the same manner as a dry plate is varnished, *i.e.*, it is held by one corner firmly between the left thumb and forefinger. Sufficient collodion to cover half the plate is then poured on the centre, and steadily flowed to the top right hand corner, down the left side, past the thumb, and off into the bottle from the right hand bottom corner, the plate at the same time being rocked from side to side to prevent the formation of wavy lines. It is now carried, face down, into the dark room, the door of which must be closed, and the room made white light-tight.

The collodion will set in a few seconds after coating, and the plate can then be placed on the dipper and lowered with one continuous motion into the solution. There must be no hesitation in immersing the plate, or it will be marked with a hori-

zontal line where the surface of the solution rested at the time of stoppage. The plate for a few moments after immersion should be gently moved about in the solution by lifting the dipper up and down. The plate is allowed to remain in the bath for fully half a minute after all apparent greasiness has disappeared, which will take place in from three to six minutes ; the plate will then have a white milky appearance, somewhat resembling a gelatine plate. On being removed from the bath, the plate is allowed to drain for a few seconds, and is then placed in the dark slide, a narrow strip of blotting-paper being placed along its lower edge to absorb any silver solution that may run down the plate. A glass plate is placed behind the metal one to prevent the latter being bulged forwards with the spring, and the slide shut.

Focussing, posing, etc., should be conducted as quickly as possible, or preferably prior to coating and sensitizing the plate, as the plate should be developed certainly within fifteen minutes of its being removed from the silver bath. It is, of course, impossible to give the length of exposure required, but the amateur should find no difficulty in calculating pretty nearly the correct time required: a positive requires only half the exposure necessary for a collodion negative, which may be reckoned as, approximately, twelve to sixteen times slower than a gelatine plate of ordinary rapidity. For a fine summer afternoon, without sunshine, full length portrait, rapid landscape lens with large stop, an exposure of from eight to ten seconds may be given, but the exact exposure can only be found from experience.

The slide, after exposure, is at once taken back to the dark room and the plate developed. The development of a wet plate, although ridiculously simple when properly understood, will be a source of mess and trouble to the beginner, unless he work calmly and with unusual steadiness. Everything that will, or may, be required should be in readiness before the ferrotype is removed from the slide : developer, cup, water (unless the sink and tap be at hand), and towel or duster. About two ounces of the developing solution is poured into the developing cup or measure which is placed to the right hand side of a bench or table opposite the ruby window. A large shallow dish should be placed on the table to catch any drippings from the plate when the solution is poured over it. The plate is now taken from the dark slide and held, sensitive side upwards, between the finger and thumb of the left hand, or if large enough the plate may be balanced upon the tips of the fingers spread out in a manner as shown in the illustration in page 529. The plate is held between the operator's eyes and the light in such a position that the movement of the liquid on the sensitive film may be clearly observed ; a quantity of the developer is then poured out of the measure on to the plate, and instantly made to flow over every part of it, without any spilling if possible. This, however, is a rather difficult operation for the beginner to perform, and it will, in all probability, be necessary to pour a fresh quantity over the plate ; the solution should be kept gradually moving over the plate by rocking it very slightly from side to side. In the course o a few seconds—a much shorter time than with a dry plate—the image will commence to appear, the high lights, of course, first ; the image will appear as a negative until fixed.

The high lights, such as face, hands, and collar, will be quickly followed by the half tones. When this point is reached, and before any detail in the shadows appears, the solution is poured off, and the plate well washed under the tap, for if development proceed any further the plate will be over-developed. It must be clearly understood that the positive must not be developed further than what would be considered half developed for a negative, as development continues during the washing, and is also more fully defined in the fixing bath.

If the positive be upon glass, when examined by transmitted light it should look like a very much under-exposed negative, the shadows should be perfectly transparent, and, if held over some dark material, and examined by reflected light, quite black ; if development has been pushed too far, or if the plate is over-exposed, a thin greyish veiling will be perceptible over the deepest shadows.

After the plate has been under the tap for a few minutes, it is immersed in the cyanide solution, which will quickly dissolve the yellowish film of silver iodide, and also produce the necessary detail in the shadows. As soon as the plate is covered with the fixing solution, the door of the dark room may be opened or the gas lit, as the collodion film is no longer sensitive to the action of light ; indeed, during the whole of the development the gas may be lit if turned low, so insensitive is the film to yellow light. When the plate is fixed, which it will be in a very short time, it is again well washed for ten or fifteen minutes, and dried, either spontaneously or over a gas flame, which may be done with perfect safety as the collodion film, unlike gelatine, is not soluble in hot water.

The film is then varnished, and if upon glass, the reverse side must be covered with a coat of Bate's black varnish. A mat of suitable shape is selected, placed in position over the plate, and secured with the preserver, and the whole is then placed in a tray and handed to the sitter—"a thing of beauty and a joy for ever." (?)

MODEL ENGINE MAKING.

By JOHN POCOCK.

V.—Turning up Cylinder—Makeshift for Slide-Rest in Boring—Mandrel for Chucking Cylinder—Steam and Exhaust Ports—Feet of Cylinder—Steam Ways—Squaring Ports.

THE cylinder being firmly chucked and properly centred, it may now be turned up with an inside tool held in the slide-rest. To do this, however, at least two cuts will be necessary. The slide-rest must be in good condition, and great care must be taken to set it parallel with the work, otherwise the cylinder will turn out taper, and be useless until it has been re-bored, even supposing there is enough metal remaining for that operation.

However, it does not fall to the lot of every amateur model engine-maker to be the happy possessor of a good slide-rest; therefore, such of my readers as are minus this useful adjunct to the lathe will be glad to hear that they may bore their cylinders in the following manner: Take a piece of beechwood about twice the length of the cylinder to be bored, and turn it down to the inside diameter of the cylinder casting. Now take two pieces of thin steel—a piece of an old saw will do very well. These may, if necessary, be softened, and must then be filed up to the shape shown in Fig. 53, the straight part, A B, being in one a shade under one inch, and in the other exactly one inch in breadth, while both pieces should be about three-quarters of an inch in length.

A saw cut is now to be made in the end of the piece of beechwood, so that the pieces of steel will just fit tightly into it. When these are placed in position, first one, and afterwards the other piece of steel (if only one piece of beech is used, but it is better to make use of a separate piece of wood for each cutter), a hole must be drilled through both wood and steel for the reception of an ordinary wood screw, the purpose of which is to prevent the steel from shifting or the wood from splitting. This hole must, of course, be countersunk at one end to take the head of the screw, see Fig. 54.

A slip of wood must be taken away with a chisel on each side, as shown in Fig. 55, to give clearance to the borings.

The steel cutters should now be hardened, tempered, and pushed into their places, and a screw put through as already explained.

The mouth of the cylinder must now be turned up so that the borer may start true; the borer is then placed in position, and the moving head-stock brought up to the back end of it. The lathe must be driven at a moderate speed, and the cutter sent through the cylinder, if possible without stopping, at a uniform speed by means of the screw in the moving head-stock.

After the first rough cut, the cutter is to be changed, and the boring finished by sending the full-sized cutter through in the same manner. The first cut may also be taken with a cutter filed up from a piece of square steel of the shape shown in Fig. 56. This cutter is to be driven through a hole bored in a piece of beech similar to that previously used.

A mandrel upon which the cylinder may be chucked while the two flanges are turned up, must now be turned from a piece of box or beechwood, and the cylinder ends finished upon it. Now in order to true the face of cylinder, it must be filed down smooth, and then stood up on end on a surface-plate, or lacking that implement, upon the bed of the lathe, and then tested with a square. File and scraper must be used until the face is perfectly square with the ends of the cylinder. A little red-lead and oil should now be smeared over the surface-plate or other flat surface used as a test, and the surface of the cylinder face tried upon it. The red-lead will show which are the high parts, and these must be filed or scraped down until the surface is perfectly flat. While thus getting the cylinder face flat, we must not, however, forget to test it occasionally with the square, otherwise by the time it is flat we may find that it has been filed and scraped out of square. Finally, to take out any scratches left by the file, the cylinder face may be lightly rubbed on a flat stone. The lugs or feet of the cylinder must be filed up square with the face.

The next operation to be undertaken is the marking out of the steam and exhaust ports. As explained in the first of these series of articles, it is impossible in these small models to keep exactly to the proportions which practice has shown to be best in larger engines, and this is the case with the steam ports. The usual practice in large engines is to make the area of the steam ports ·057 (or about one-twentieth) of the area of the cylinder, and the length of the ports is taken as seven-tenths of the diameter of the cylinder. In this small engine the nearest approach to theoretical correctness is to make the steam-ports $\frac{3}{32}$ by $\frac{3}{8}$ of an inch, but this will be very close work, leaving no margin for accidents, so that it is perhaps better to reduce the latter measurement to $\frac{1}{4}$ of an inch, in which case the last lines drawn upon the cylinder face must be $\frac{1}{8}$ of an inch from the horizontal centre line, and the centre marks punched in accordance with the alteration.

To mark out the steam ports it is best to use a scribing-block and surface-plate, but failing these tools, a pair of dividers or callipers may be used. Before commencing to set out the ports, and espe-

cially if dividers or callipers are used, make sure that the cylinder face is itself square. Now stand the cylinder on end on the surface-plate, and set the point of the scriber as near the centre as possible ; mark the cylinder face very lightly with the point of the scriber, and then, without moving the latter, reverse the cylinder, standing it on its other end, and again mark the face. The centre of the face will, of course, be a point midway between the two marks. Now place the cylinder horizontally on its feet, which should have been previously filed up square with its face ; and again set the scriber point as near the centre as possible, and mark ; reverse the cylinder, placing small blocks of wood under the face to keep it steady and square with surface-plate, mark once scriber, or by means of the dividers, draw six lines, three on each side of the vertical centre line, the first pair being each a full $\frac{1}{16}$ of an inch from centre line, and the second and third pair $\frac{3}{32}$ of an inch from the first and second pair respectively. Now mark two lines each $\frac{3}{16}$ of an inch from the horizontal centre line ; the ports will now be all marked out, and the cylinder face will exhibit the appearance shown in Fig. 57.* Now with a punch make three centre marks in each of the spaces marked out for the ports, one mark being made in each case in the centre of the space marked out, and the other two each $\frac{1}{8}$ of an inch from this centre, one on each side. These centre marks are also shown in the figure to which we have just referred. We next centre mark

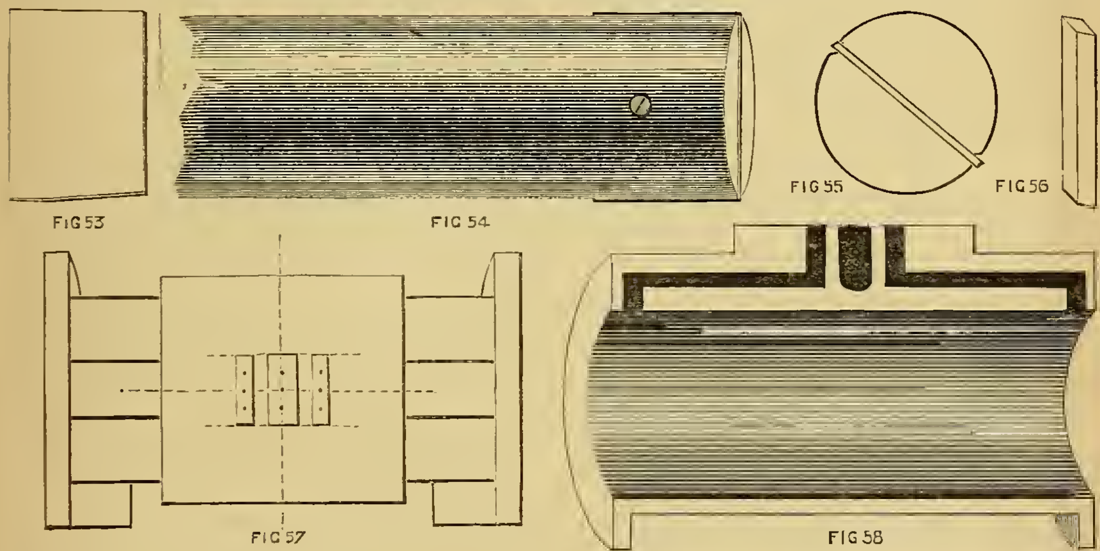


FIG. 53.—CUTTER FOR BORING BAR. FIG. 54.—BORING BAR. FIG. 55.—END VIEW OF BORING BAR. FIG. 56.—ALTERNATIVE FORM OF CUTTER. FIG. 57.—FACE OF CYLINDER, SHOWING POSITION OF STEAM AND EXHAUST PORTS. FIG. 58.—SECTION OF CYLINDER, SHOWING STEAM WAYS.

more with the scriber point, and rule centre line between the two points marked. The first or vertical centre line should, when drawn, be continued across the face of the cylinder and the boss for exhaust pipe, while the horizontal centre line must be continued along the metal left for the steam ways and across the flange of cylinder at each end.

Should the feet of the cylinder stand out beyond the flanges, or the flanges themselves be partly filed away during the process of filing the feet square with the cylinder face, allowance must, of course, be made for such difference when marking the horizontal centre line ; this precaution will not be necessary if the face is marked out with the dividers, as the horizontal centre line will then be marked from the edge of the cylinder face, the vertical centre line being taken from the flanges of the cylinder. Now with the for the steam ways on that side of each flange which is nearest to the cylinder face. These centre marks must, of course, be made upon the continuation of the horizontal centre line already marked, and must be made on about the middle line of the thickness of the metal in which the steam ways are to be bored, but, if anything, rather nearer to the inner than the outer side.

The steam ways should be drilled down to within $\frac{1}{4}$ inch of the centre of cylinder face, the drill being inclined slightly outwards so that the steam ways are drilled towards the surface of the cylinder face. With the same drill make the three holes for the

* Owing to a valve casting belonging to another set having been accidentally sent by the manufacturers, and Fig. 57 drawn therefrom, this Fig. does not answer in all its measurements to the description given in the print,

exhaust port as already marked. These holes should be rather under $\frac{1}{4}$ inch in depth; and next, using the $\frac{1}{8}$ inch drill, or one slightly larger, make the exhaust way through the boss into the three holes just drilled. With a $\frac{3}{32}$ inch drill make three holes in each steam port as marked. These holes should be drilled outwards towards the ends of the cylinder, to avoid any risk of their running into the exhaust port; the two sets of holes must, of course, be drilled down into their respective steam ways.

The ports may be left as they now are, but they will look more workmanlike, and the engine will also work better if they are squared out to the lines marked with a small chisel.

If it is intended to square out the ports, it may be advantageous to drill two steam ways, each $\frac{3}{32}$ inch in diameter (instead of the one $\frac{1}{8}$ inch) at each end of the cylinder, for the two $\frac{3}{32}$ inch ways will have a rather larger total area than the square-cut port, while the $\frac{1}{8}$ inch steam way will have an area rather less than the square ports.

The side of the cylinder must be chipped down a little so as to make a clear way between the end of the steam ways and the interior of the cylinder when the cylinder covers are on; or a way may be made with a drill, and the end of the steam way showing in the cylinder flange may be stopped up with a small piece of brass wire.

In my next I shall consider the turning of the cylinder covers.

(*To be continued.*)

MAP COLOURING, MOUNTING, ETC.

By JOHN BRION, *Constructor of Relievo Maps to His late Royal Highness the Prince Co .ort, Author of the "Construction of Relievo Maps," the "Renovation of Paintings," etc.*

III.—MAP COLOURING BY LITHOGRAPHY—MOUNTING TOURISTS' AND POCKET MAPS—MOUNTING WALL AND LIBRARY MAPS—SIZING AND VARNISHING—ROLLERS AND CABINETS—CONCLUSION.

A LARGE portion of map colouring, especially in bookwork and cheap atlases, is accomplished by lithography, which art has attained such excellence as to render it a formidable competitor with handwork, but, as in cases where there are many colours, each requiring a separate printing, the cost is nearly as much as that of pencil work, and the best examples of lithography rarely equal really good handwork; especially in large maps, pencil colourists have yet a good field for their labours.

It is not my intention to treat of the process of lithographic printing; that has been already most ably done by Mr. H. E. Grantham, in Vol. IV., AMATEUR WORK; and beyond saying that the method for preparing tracings for the lithographic colour-stones is the same as that used for obtaining drawings for stencil plates, and that each colour requires a separate stone and a separate printing, we need only add: That in the example of the colouring of the map of England, given in Chapter II., all the yellows would be upon one stone, the lakes upon another, and so on till the six colours were completed, when the map would be coloured by successive printings, like ordinary lithographic work. After the articles by Mr. Grantham, it would be useless repetition, and very bad taste on my part, to go further into the details of lithography. I advise such of our readers as wish to acquire a thorough knowledge of this species of map colouring to study Mr. Grantham's articles in connection with my preceding Chapters I. and II. We have now done with colouring, and will proceed to mount our maps.

Pocket, Tourists', and other Folding Maps require to be very carefully done. Suppose that we wish to mount one of these, size 36 inches by 24 inches. Provide yourself with a stretcher an inch larger in every way than your map. Upon this strain a piece of fine white calico, which should not contain the chalky "dressing" so liberally used by manufacturers; the calico should be cut an inch larger than the stretcher all round. Lay it upon your table or bench, and the stretcher upon it. With small tacks, driven into the *edges* of the stretcher, strain your calico evenly and tightly over the frame. If any slackness or creasing exists, untack one side or more if needed, and smooth out or tighten the objectionable parts till the face of the calico is as even and tight as the head of a drum. Do not spare a little labour on this, for if your cloth be improperly mounted, your map must be disfigured. Suppose the "straining" to be done: Take your map, lay it upon a smooth board, and with a bleacklead pencil divide the margins lengthwise into eight divisions, each of which should accurately measure $4\frac{1}{2}$ inches; divide in like manner the sides of the map into four divisions, each measuring 6 inches. With a flat rule and pencil unite the opposite points of marking; when finished the map will present this appearance. See Fig. 6.

If you find, upon testing, that your divisions are accurate, with a keen knife and flat rule cut off the portions 1 2, 3 4, 5 6; then proceed to divide the slip 1 2 into sections R, S, T, U, and so on till the map is separated into thirty-two pieces. To prevent these becoming mixed or confused, it is well to number them upon the backs as the cutting proceeds. If you have any doubt of your ability to obtain accuracy, it will be well for you to practise upon a blank sheet of paper before cutting your map, for a false measurement or cut will ruin your work. The next step will

be to mount our divisions upon the calico : Prepare paste by taking, in the proportion of half a pint of wheaten or cornflour to a dessertspoonful of powdered alum, mix with cold water to the consistency of thin cream, boil ten minutes, constantly stirring, over a slow clear fire. Do not use till cold. Lay your mounted calico, face upwards, before you, under it put a piece of smooth board to fill up the hollow space between the inner edges of the stretcher, and to provide a level and solid surface beneath the face of the mounted calico. Apply a "straightedge," *i.e.*, a flat rule, to that part of the calico represented by the line 1 2, Fig. 6, and secure it with weights or tacks at the ends 1 2. Paste division R of the map, taking especial care that the paste is well rubbed into the edges and corners; lay it upon the calico at R, cover it with a piece of clean white paper, and with a hard clothes-brush or a duster rub firmly over the space occupied by the section of the map beneath. Do likewise with section S, keeping the bottom of it to the edge of the rule, and allowing about one-twelfth of an inch of space between the divisions R, S, *vide* Fig. 7. In this manner mount the eight divisions on line 1 2, then remove your "straight-edge" to line 3 4, allowing for one-twelfth of an inch of space to be left at the bottom of line 1 2, when the next row of sections is mounted, *vide* Fig. 7. It will be well to use a T-square in order to secure perpendicularity of the lines A 1, B K, and so on, to the horizontal lines 1 2, 3 4, 5 6, Fig. 6.

Mount all your divisions by the foregoing instructions, and if your work has been well done, it will present the appearance of the sections in Fig. 7. The use of the spaces between the divisions of the map is to allow of its being easily and compactly folded; without this device the map would be a clumsy affair, and soon be broken up. When the whole of your divisions have been mounted, turn your map, with its face downwards, upon any level surface covered with white paper, and with a clean cloth rub the back of the map firmly so as to cause any loose or blistered portion of the map beneath to adhere to the calico. Let your work remain at least twenty-four hours in a warm room to dry, remove it from the stretcher, cut the margins neat and square, and fold by the following directions, *vide* Fig. 6. Bring the line B K, upon the line 1 3 5, D M upon B K, F O upon D M, H Q upon F O, which completes the first folding. Under your last fold, H Q, there are H, 2, 4, 6, Q, *vide* Fig. 6. Bring the *back* of 4 upon the *back* of H, and the *back* of Q upon the *back* of 4. The map is now compactly folded into book-form 6 inches by 4½ inches. *Note.* From not knowing the simple rule for folding maps much annoyance is often experienced, and good works are brought to grief. Place your map when folded under a heavy weight or in a press for a few hours, then put it into a book-like cover or into a case. If any of our readers wish to make their own map covers or cases let them consult Vol. II., AMATEUR WORK, where they will find able articles on Bookbinding, etc.

In mounting the large wall-maps, of which we have described the colouring in divisions, the same methods as the foregoing are followed, excepting that no spaces are left between the sections ; on the contrary, the lines of junction should be united with such precision as to leave no trace of the joining. Margins are usually left to maps printed in divisions. Before mounting, one of these is cut off, and the edge thus obtained is mounted *over* a margin of another of the divisions that has been left on, exactly after the manner of paper-hanging. For single sheet maps no special instructions are needed, for those which apply to divisions will serve for a whole. One hint, however, may not be useless. After the pasting of a map, or any portion of one, let it lie three or four minutes in order that it may fully expand under the influence of the wet paste ; if this be neglected you may be perplexed with blisters, wrinkles, etc., upon your work. An assistant will be required to aid in laying the pasted sheets level upon the calico of large maps. Those who are desirous of making their own stretchers for mounting will find full directions in Part 20, pages 411 and 412, Vol. II., AMATEUR WORK.

When the mounted maps are perfectly dry, they are "sized," *i.e.*, covered with a thin coat of gluten in order to protect the paper from being discoloured by the varnish; various substances are used for this purpose: isinglass, gelatine, parchment cuttings, and a preparation known as "patent size." Isinglass is excellent, but too costly, except for globes and very valuable maps. Gelatine has most of the good qualities of isinglass, and is not one-fourth of the price ; both are prepared for use by dissolving them in a sufficiency of hot water to produce a solution of the consistency of thin cream. Parchment cuttings may be had of stationers and bookbinders at a cheap rate. Put a quarter of a pound of cuttings into three pints of cold water, simmer very slowly in an enamelled or well-tinned saucepan for an hour ; strain through a hair sieve or a piece of muslin, and you will have a size not to be excelled in clearness and durability. Patent size is made from the parings of the hoofs, etc., of young animals. It is sometimes very good, but is not always reliable, and in a few instances I have found that it has damaged the pigments used in colouring. I would, therefore, say to all—prepare your own size, either by using gelatine or parchment cuttings, and thus prevent any risk.

Choose a dry, warm room wherein to work, and in cold weather have a fire therein. Warm your size

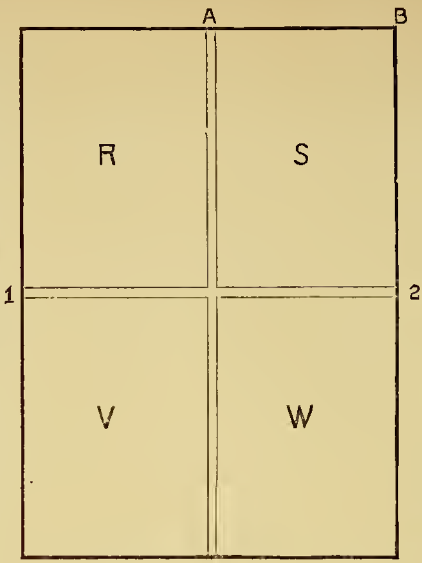


FIG. 7.—ENLARGED VIEW OF PART OF FIG. 6, SHOWING SPACES TO BE LEFT IN MOUNTING.

before using so as to have it perfectly liquid, and keep it in that state while working. Use a hog-hair sash-tool or, on very large maps, a one pound hog-hair painter's brush. On small, delicate work, a flat two-inch camel or hog-hair may with advantage be employed. Take care to have plenty, but not a superabundance, of size in your brush; lay it on the map in broad washes from right to left, or from the top to the bottom; be sure that you do not omit to cover a single point, and, moreover, do not work your brush repeatedly over the same place or the size will "scale and lather," and give much trouble to clean off, resulting, probably, in damage to your colours. A steady, regular, brisk action of the brush in broad bands, with a full tool, the edge of each wash slightly overlapping the other, and avoiding anything like producing "pools" of size, is the kind of work to be aimed at. One coat of size must be thoroughly dry before you apply another, or you will risk tearing off the first coat in "scales." The time required for drying depends entirely on the weather or the warmth of your workroom. From six to twelve hours may be taken as the necessary interval. Two coats of size are usually given, but if your size be very thin, or you have any doubts of two coats being ineffectual, give a third. *Note.*—When making or preparing the size, you will do well to try it on a piece of blank paper; by drying the sized paper before a fire you can give two or three coats in a few minutes. Test the paper by giving it a coat of varnish; if it is penetrated and discoloured by the varnish the size is too weak, and must be strengthened by adding more parchment or gelatine to that which you have prepared. If it is too thick, and works heavily, add water to liquefy it. Size properly prepared should work as smoothly as cream and resist the action of varnish in two coats.

Mastic varnish is unquestionably the best for maps as well as for pictures, but the high price prevents its use save for globes and other first-class work. Good paper varnish, price 10s. to 12s. per gallon, well mixed with terabine in the proportion of a wine-glass full of the latter to a quart of the former will serve all ordinary purposes. The terabine causes the varnish to dry quicker, and prevents the "tack" (stickiness) that often results from using indifferent varnish. In varnishing it is best to use a two-inch flat brush, camel or hog-hair, as you may choose. Work in a very warm room, and in cold weather before a fire. Place your varnish bottle in a basin of warm water for a few minutes; pour out a sufficiency in a saucer or galley-pot. Charge your brush fully, but not to repletion; work quickly, as in sizing, in bands from right to left, or from top to bottom. Go over no part a second time. When finished, lay the map horizontally upon a bench or table for an hour or two that the varnish may set. Avoid laying work upon the floor as the draughts of air may cause the wet varnish to "curdle" or "wave." In about twelve hours you may give a second coat, and after a day's interval a

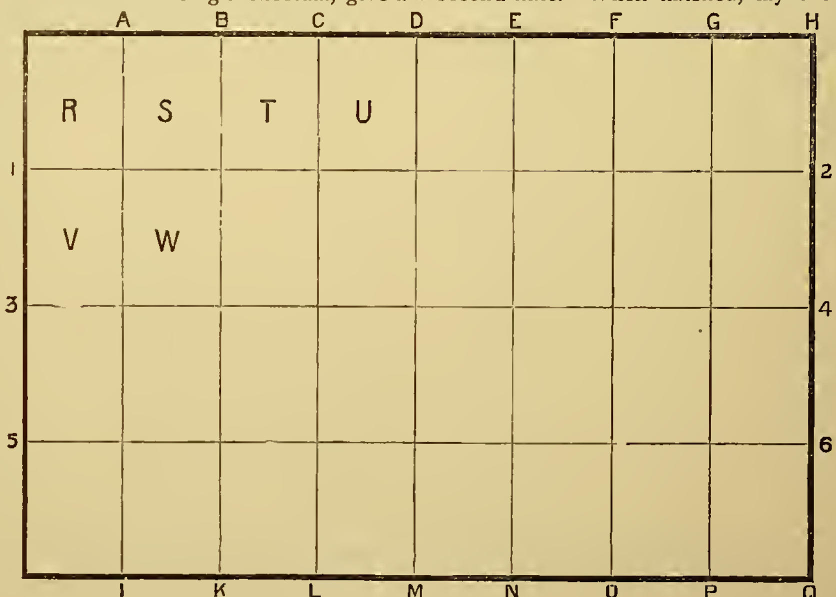


FIG. 6.—DIAGRAM SHOWING POCKET MAP CUT FOR MOUNTING.

FIG. 11.—CABINET FOR MAPS.

third may be applied if needed. It is better to give three thin coats than two thick ones; the effect is better and the cost of varnish is no greater.

The map should not be removed from the mounting stretchers for several days after the last varnishing, nor while they have the least "tack" upon them, or they will be liable to damage from finger-marks, etc. When perfectly dry cut them loose from the stretchers. Trim the edges accurately, and fix them to laths and rollers, or fit them into cabinets.

The ordinary lath and roller are too well known to need description, but hints concerning a very effective addition to them, for superior work, as library maps, and plans of estates, may be acceptable to our readers: Let A B, C D, Figs. 8 and 9, represent an ordinary lath and roller. Into the parts 1 2, 3 4, let a groove be cut allowing the insertion of a thin slip of gilt moulding. The lath and roller must be of sufficient thickness to admit of the moulding being placed at such a depth so as not to interfere with the rolling of the map. The gilt need not be broad; a narrow piece of good "slip-hollow" gives an excellent effect. Some time since I saw such mountings in the library of a nobleman, and the effect of the gilt against the dark laths and rollers was very chaste and rich.

The common method of attaching maps to their laths and rollers is open to great objection; I consider it to be the weakest point in map production. As the reader well knows, it consists in nailing the top and bottom edges of the map to the lath and roller with a few flat-headed tacks, a piece of common tape forming the only base of support between the heads of the tacks and the map. The arrangement is at variance with the simplest principles of mechanics. The results are, the maps break away at the corners, and oftimes in the middle, when the unfortunate sheets bulge and hang with drooping ends like sails damaged in a storm. In large maps, and especially in plans of estates which are frequently in use, I have found the following simple method answer well: Let A B, Fig. 10, represent the back of a map-roller or lath into which a groove, C D, has been cut to a sufficient depth, but such as will not endanger the strength of the wood. Provide strips of good wood to fit loosely into the groove and flush with the surface. Fold the outer edges of the map by a straightedge, so as to fit within the groove. Glue the groove well, place the proper edge of the map within it. Quickly glue your slip, and force it down upon the map into the groove; secure it with a few French tacks of sufficient length to go through the slip into the wood of the lath, but not to penetrate to its face, and your work is completed. It will be evident that by this simple method we get continued support along every portion of the line, C D, instead of, as in the old method, by the broken points represented by the tacks, C, E, F, G, D. We leave the consideration of this elementary principle to the consideration of our readers. Library maps

FIG. 8.—MAP ROLLER WITH GILT MOULDING.

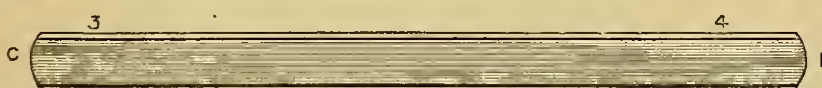


FIG. 9.—MAP-LATH WITH GILT MOULDING.

FIG. 10.—BACK OF ROLLER ON LATH WITH GROOVE FOR MAP.

are frequently mounted in a cabinet, Fig. 11. They will contain from six to a dozen or more maps. They are fitted with springs which allow the maps to be drawn up and down like window blinds, according as they may be wanted. It will be seen at once that this arrangement economises space greatly. Such of our readers as have profited by the many able articles on "Cabinet Making," etc., in AMATEUR WORK, will have no difficulty in constructing such an article of convenience and luxury, and I hope that some one of my brother readers will, ere long, tempt our worthy Editor with an article on this matter.

We said at the commencement of these articles that many persons earned a good living at map colouring. It has several things to recommend it: The work is clean, it is generally done at the colourist's home, and the prices given are very fair, for some work, good. If any of our readers wish to make it a source of income we recommend them to study and practise what we have given in these papers. Uncoloured maps may be bought from a penny each and upwards, upon which you can try your skill. Procure a well-coloured one as a guide, and when you feel tolerably competent get a few lessons from an experienced colourist who can impart much information which it is impossible to convey in print. Such an instructor may be found, by anyone who desires it, in Mrs. Adams, 2, *Wornington Road, North Kensington*, who has for many years worked for the largest map publishers in London.

CIRCULAR SAW BENCH,

WITH PLANING, GROOVING, REBATING, AND MORTISE-BORING ATTACHMENTS.

By OLLA PODRIDA.

PART IV.—PLANING ATTACHMENT—DESCRIPTION OF DIAGRAMS IN FOLDING SHEET—DETAILS OF PLANING GEAR—"DRUNKEN" SAW.

THE planing attachment will now be treated upon according to promise, and in order that this important part may be thoroughly understood, a special Folding Sheet illustrating the Saw Bench as adapted for planing, is presented with this Part. Being drawn to a larger and more convenient scale, it may also assist to clearer comprehension of the construction, of the upper part at least, of the framing of bench, and as such might be considered supplementary to the large Folding Sheet presented with Part 54. To further this intention the lettering and figuring of the different parts has been maintained, or rather repeated for the benefit of the amateur.

Referring to the Folding Sheet, Fig. 46 is a front view of the upper portion of the machine, the lower part for economy of space being supposed to be broken away as shown. Fig. 47 is a sectional end elevation through A, A, in Figs. 46 and 48—*i.e.*, Fig. 47 represents the upper part as it would appear if cut down through A, A, and the left hand half removed. Fig. 48 is a plan of the machine showing the table as it would appear in looking down upon it.

It will be observed in Figs. 46 and 48 that the original fence F, as employed for circular sawing, is retained to act as a guide to the right hand side of the material while being planed. On the left hand another fence F, F, of simpler form will be seen; this is also adjustable within the limits of the slots, and secured by means of ordinary wood screws, as shown by dotted lines at *a*, *a*, in Fig. 48. The arrangement for keeping down the material to its work, and also for maintaining a uniform pressure thereon, is shown at *s*, in Figs. 46 and 47. This apparatus consists of a double-ended spring secured to a block of wood, *k*, which is adjustable in a vertical direction through a slot, *t*, in the fence F, and secured thereto in any desired position by means of a small bolt with a butterfly, or thumb-nut. This is shown more clearly in Fig. 46. The spring is given in detail in Figs. 52 and 52*a*, elevation and plan respectively, and drawn half size. The block, *k*, is given in detail on a scale of one-fourth full size in Figs. 53 and 53*a*.

In Fig. 48 the gap is considered to be removed, so that greater clearness may be given to the arrangement of the members of the table around the edge of the opening. The method of supporting the gap piece at the ends will also be clearly seen in Fig. 47, the tongue being employed for the purpose, while to support the sides the middle portion of the table is rebated down to the level of the tongues on each side.

The block for carrying the planer cutters is shown at Figs. 49 and 49*a*. Provision is made for carrying a small additional cutter at *s*. The cutters are shown at Figs. 50 and 50*a*—Fig. 50 being a full width one, and 50*a* a narrower but more useful one. The edge view of these cutters is given at B on the left hand. The securing bolts are shown at Figs. 51 and 51*a*.

Fig. 54 is a side elevation of the gap piece, and 54*a* an end view of the same. The construction of this part, as also of the other details will be entered upon and fully described further on.

Fig. 55 represents the "drunken" saw as mounted upon the spindle. The washers are given in detail at Fig. 56. This device, which is very useful in grooving and rebating, will also receive attention later on.

Having briefly described the various parts, we may now enter upon their construction in detail.

Gap Piece.—This should be made of hard wood, such as mahogany or beech, the latter being preferred.

A piece 12 inches long by 5½ inches wide and 1¼ inch tbick, when finished will be required to make the top. This must be rebated all round to suit the aperture in table top. It must be well and carefully fitted into the aperture, so tbat there may be no shake or looseness wbatever, and also specially well "bedded" to ensure its being stable and firm in its seat, with perfect freedom from "rock," or unsteadiness. It must also be quite flusb and truly level with the table top. To ensure tbis it must be left a little tbicker than required, so tbat wben properly bedded it may stand a little bigher tban tbe surface of the table. This will permit of its being planed off in place, which must be done *after* tbe stiffening ledge has been screwed on underneath. This ledge should be made of similar material to tbat used for the top, and secured to it by means of stout wood screws. To make the ledge a piece of stuff 11 inches long by 2 incbes wide and ¾ incb thick when finisbed will be required, tbe ends being tapered and rounded off after the fasbion shown in Fig. 54. Tbe clearance opening for tbe cutter and block must be cut V-sbaped, as shown in Figs. 47 and 54, and need only be large enougb to clear the block endways and allow tbe cutters to revolve at about ⅛ or ¼ of an inch above the surface of table—an eighth of an inch will be ample. This clearing hole for the block need not be cut further than is shown as far as by the dotted lines at *a a* in Fig. 54*a*, so as to maintain, as far as possible, the stiffness of tbe gap piece.

Additional Fence.—No detail of this is given, it being unnecessery. Its shape is given in dotted lines at F, F, in Fig. 48. The thickness is ¾ of an inch, length 16 incbes, and breadtb 6 inches. This thickness will suit all classes of work, from ⅞ of an inch and upwards for thickness. For thinner stuffs it may be necessary to use a thinner fence, according to requirements. For instance, in planing half inch or tbree-eightb stuff, a fence $\frac{5}{16}$ of an inch thick would be suitable. Thin metal washers should be interposed between the heads of the screws and the fence to prevent splitting and also to ensure firmness.

Block for Spring.—This is given in Figs. 53 and 53*a*. The form is very simple. Hard wood must be employed, say beech. The finished size is 4 inches long by 2 inches wide, and 1 inch thick. A hole must be bored to accommodate a ⅜ inch bolt, and this bolt should be a snug fit. The slot in the fence at *t*, in Fig. 47, must be cut low enough to allow of the spring being brought right down on the gap. In adjusting tbe spring it must be kept level with the surface of tbe table, so that the pressure may be as nearly as possible equal on each arm.

Spring.—This part will be rather beyond the capabilities of an amateur, but may be made by an intelligent smith, from the drawings given in Figs. 52 and 52*a*. It is $\frac{3}{16}$ of an inch thick on the back, and tapers gradually towards each end "to nothing," as shown. The width is 1¾ inches. The arms must be kept fair and level with each other and with the underside of the back. They must also be filed up and polished smoothly at P, P, so that as little resistance as possible may be offered to the wood while being passed underneath. "Spring" steel should be employed in its manufacture, but failing that good cast steel may be substituted. It must also be carefully tempered after the holes for wood screws have been drilled and countersunk and the parts at P, P, filed up.

Cutter Block.—This part is beyond the resources of most amateurs, a left-handed thread having to be cut within it to suit the nose of spindle. As already noted, a slot is shown at *s*, for the reception of a small cutter, if required. This cutter would be secured by means of a small screw fitting into a hole tapped in the outer end of block as shown. This small cutter provision would be very useful for grooving, rebating, or beading small works.

The Britannia Company, *Colchester*, will, I may venture to say, supply this, or any of the metal parts, on application. This Company being constant advertisers in AMATEUR WORK, it will only be necessary in ordering any of these parts to quote the description of article and number of Part or page in which it is described.

Cutters.—These must be made of the best cast-steel, very carefully forged and tempered. Although they may be made by the amateur himself from the rough forgings, it will be cheaper and more satisfactory to obtain them from a firm experienced in the manufacture of such tools. If not carefully forged and tempered there is great risk of their breaking suddenly and flying "all over the shop," to the danger of the operator.

Bolts for Cutters.—Tbese may be made by the amateur, providing he is the possessor of a small lathe and suitable gear for screwing them and tapping the nuts. The head must be turned up to the dotted lines in Fig. 51, and the flats filed afterwards to fit the V-grooves in cutter block. The nuts should be good fits in all cases, so as to guard against their slacking back while running. Thin washers must be interposed between the nuts and cutters, so as to cover the slots in the latter.

Drunken Saw.—This will be found a very useful adjunct, being readily rigged up and speedy in its action. Fig. 55 will convey a good idea of the method of fixing it for use. A stiff saw, about 4 inches in diameter and of moderately coarse pitch, will be most suitable. One pair of the bevelled washers, shown at Fig. 56, will be sufficient for most purposes. With

them the saw may be set at any angle, from 0 up to their limit of taper. The washers may be made of brass, but lignum vitæ, or similar hard wood will answer very well. Of course, the use of this saw will necessitate a modified form of gap to allow for the oscillation. A plain one, similar to that employed for circular sawing will do, there being no necessity for a stiffening ledge as in the one for planing.

In the next chapter it is my intention to treat upon the different classes of works which may be done in this machine, and the manner in which they may be executed.

(*To be continued.*)

THE ECCENTRIC HAND-REST, AND HOW I MADE MINE.

By J. L. DWYER, B.A.

MANY of the modern inventions in all departments of practical mechanics have for their object the saving of time of the operator. This saving of time is also saving of money to the professional, and although we amateurs can scarcely look on the matter in that light, who does not feel happier when he can regulate his vice, his chuck, or his hand-rest in a second without the bother of fumbling about screws and spanners.

My hand-rest was for some time a cause of annoyance from the peculiar construction of the lathe. The latter, standing close down to the table, prevented me from getting my hand conveniently under the bed, while the gap and stays also conspired to make the usual plan impracticable. Even in a lathe standing on standards, with ever so much of a clear space under the bed, the gap and stays will be found in the way.

My plan was to have a plate with a bolt welded to a hole in the middle, Fig. 1. This was passed up from underneath, and a nut secured it. By simply loosing the nut the rest could be drawn in or out, turned to any angle, or moved from end to end of the bed, the plate passing over the stays. This plan, however, did not satisfy me, so I determined to make an eccentric rest. From the Britannia Company, *Colchester*, I obtained the materials, castings, and forgings of a 3 inch rest for 2s. True, I got them with some other castings, and had to pay 1s. 3d. afterwards for some parts which did not arrive, including the spindle of the hand-rest, but I believe this must have been a mistake, as they said in a former communication that "the price (2s.) includes all materials for making up."

I mention this lest anybody should accuse me of falsehood. A post-card to the Company will at any time, I can say from experience secure a courteous answer.

The lower edges of the body of the rest are first filed flat, an old file removing the scale, and better ones being then applied. Very little filing is required, the edges being only about three-eighths of an inch wide on the average. I used the bed of my lathe as a surface plate, by covering it with a thin coating of red lead, and putting the rest on it, and then rubbing the latter slightly, the high parts are easily marked. These are filed down, and the process repeated until the whole of the filed edges of the rest become marked.

The hole for the T's is next bored out by clamping to a face-plate of a large lathe, and boring out with an inside tool (for the hole is cored out), or else using a twist drill. The ordinary diamond drill would not bore a cored hole true or round, except the hole was filled up for the purpose. A sort of drill, though, which makes a beautifully true hole, can be made by turning down a piece of steel for an inch or two parallel, and then reducing considerably Figs. 2, 3, and 4. The parallel part is then filed, leaving half the metal remaining, as is seen. The point is then filed flat, sloping slightly from the left-hand corner (looking at the flat), which is the cutting edge. If a seating about a quarter of an inch deep be turned in a piece of work, and the point of this tool inserted, a perfectly round and parallel hole will be bored, the poppit being used to push the tool forward.

I often wondered how they bored steam cylinders before they invented slide-rests, and was told by an engineer that they used this sort of drill. This might be worth knowing to those who find a difficulty in boring a model cylinder.

Of course, when I say the parallel part should be an inch or so long, I mean for a drill about $\frac{3}{4}$ inch in diameter, as this will, I suppose, be nearly the size of the T shank. A large range is admissible here, the pillar being $1\frac{3}{8}$ inch in diameter. A $\frac{3}{8}$ inch hole may now be bored and tapped in the lug provided for the set screw.

Stand the casting now on the lathe bed or surface plate, and draw a line perpendicular to the lower edge along the centre of the casting at each end as shown, Fig. 12. A point, B, is taken in this line $\frac{5}{8}$ inch full from A, and centre punched. A $\frac{7}{8}$ inch hole slack is bored at the pillar end, and $\frac{1}{2}$ inch hole slack at the other. By slack I here mean $\frac{1}{32}$ of an inch less, not wishing to use such fractions as $\frac{23}{32}$ of an inch, or $\frac{15}{32}$ of an inch.

The spindle is now prepared to fit those holes. The piece of iron supplied is $\frac{7}{8}$ inch in diameter, and $9\frac{1}{4}$ inches long. The ends having been flatted, it

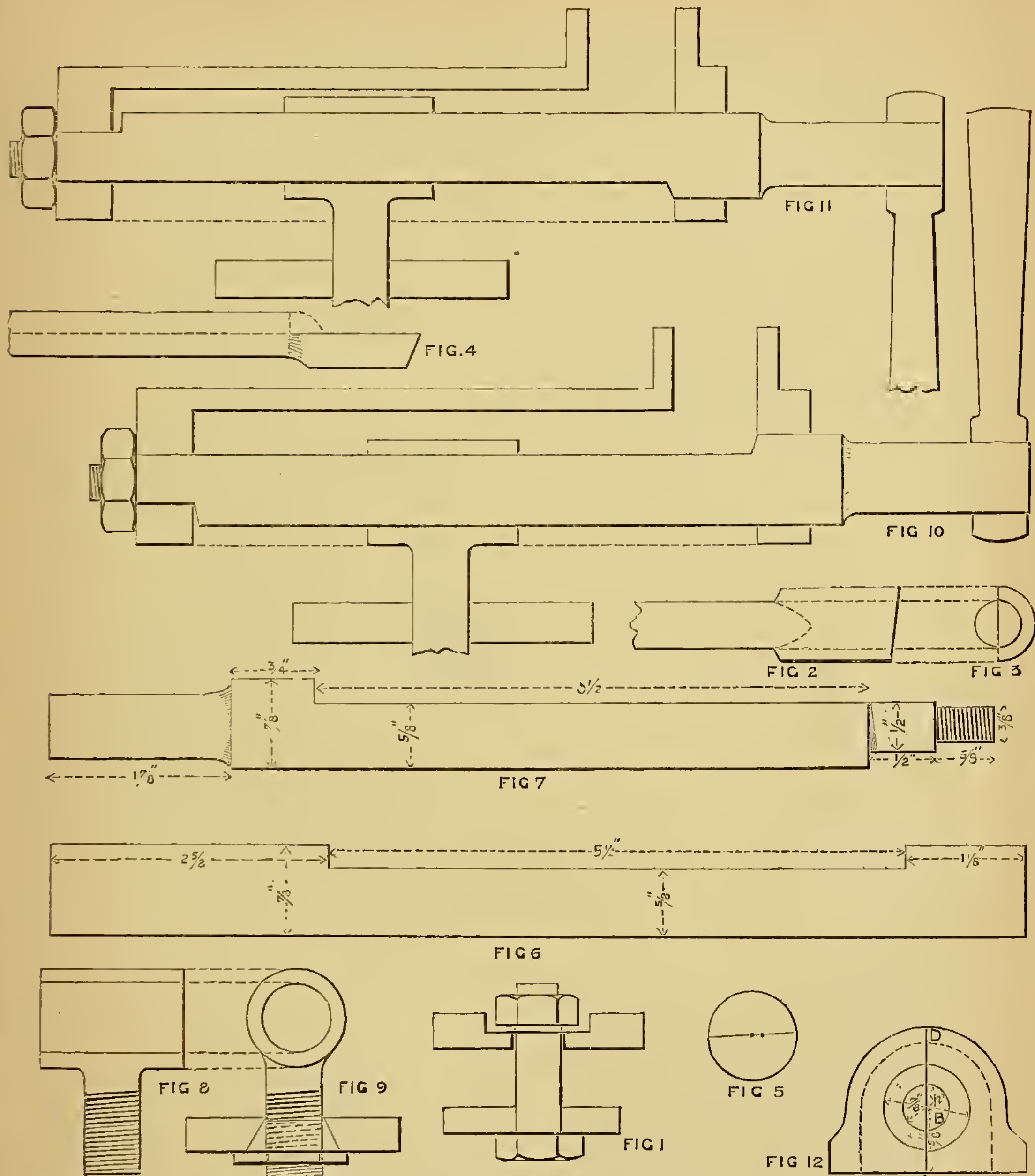


FIG. 1.—OLD FORM OF REST. FIGS. 2, 3, 4.—FRONT, END, AND SIDE VIEW OF CIRCULAR DRILL. FIG. 5.—END OF ECCENTRIC SPINDLE. FIG. 6.—ECCENTRIC SPINDLE PARTLY TURNED. FIG. 7.—ECCENTRIC SPINDLE FINISHED. FIGS. 8, 9.—STIRRUP, CLAMPING PLATE AND NUT. FIGS. 10, 11.—DIAGRAMS ILLUSTRATING ACTION OF REST. FIG. 12.—END OF REST, DOTTED LINE C D E REPRESENTS ABOUT CAVITY.

must be centred truly, then laid on a flat surface, prevented from turning, and lines drawn through the centres parallel to the surface. A narrow strip of wood laid on the surface will do nicely for a guide. Dots are now punched on this line $\frac{3}{32}$ of an inch from the centres already marked, taking care, of course, that they are at the same side of the centre dot at each end, Fig. 5. This gives us $\frac{3}{16}$ of an inch eccentricity. Tiny holes are bored for the lathe centres, and the spindle is turned. The eccentric part is first

done, while the bar is strong. It is $5\frac{1}{2}$ inches long, from one end it is $1\frac{1}{8}$ inch, and from the other $2\frac{5}{8}$ inches, Fig. 6. This part being turned down until round will be found to be $\frac{5}{8}$ inch full in diameter.

The bar is then put on the other centres, and the ends turned down as shown at Fig. 7. The left-hand end is turned to $\frac{11}{16}$ of an inch for lightness ; next comes a piece to fit the larger hole in the casting ; then the eccentric part as mentioned before, then a piece $\frac{1}{2}$ inch full to fit second hole, and $\frac{1}{2}$ inch long, and finally a screw for a $\frac{3}{8}$ inch nut.

The handle must next be prepared. That supplied of malleable cast iron, is a capital shape, and will only require a little turning and polishing to make it perfect. A hole, $\frac{1}{2}$ inch in diameter, is bored in the end to take the spindle, and afterwards squared. The end of the spindle is also squared for about half an inch of its length, and the handle nicely fitted on. An easier way, perhaps, to fit the handle, would be to bore a hole $\frac{11}{16}$ of an inch to fit the spindle direct, and secure with a key.

We are now approaching the conclusion of our work. The piece, Figs. 8 and 9, is bored out to fit the eccentric part of the spindle, and the tang is screwed for a $\frac{1}{2}$ inch nut. It will be seen that I had to cone the nut and clamping plate, leaving only about one-eighth of an inch for a spanner. This was necessary to escape the stays of my lathe bed, but the nut being somewhat loose, I never require to use a spanner.

If everything be put together now as in Fig. 10, it will probably be found that the spindle will not revolve owing to the stirrup coming in contact with the top or sides of the cavity. The former must, therefore, be filed down until it clears. It should not, however, be made thinner than $\frac{1}{8}$ of an inch, but it will not require it. Any prominent parts of the cavity should be filed level.

Figs. 10 and 11 explain the action of the rest. In Fig. 10 the handle is turned up, and the clamping plate is a certain distance from the lower edges of the rest. In Fig. 11, however, the handle is turned down and the clamping plate brought $\frac{3}{16}$ of an inch nearer the edges. If the cheeks of the bed are between the clamping plate and body of the rest, the latter will be firmly held, but can be loosed and moved to any position in a moment without the least trouble. The nut underneath regulates for the thickness of bed cheeks. I consider the manufacture of this article peculiarly suited to many of the readers of AMATEUR WORK. Few of the existing lathes are fitted with such a belonging, while in itself it is so valuable, and so easy of construction, that I am sure it only requires to be brought before our attention to be extensively adopted. Unlike the slide-rest, no part requires great accuracy, and it can be attempted by the veriest tyro with as much chance of success almost, as by the cleverest professional.

The principal objection against it is that it takes up a good deal of space on the lathe, reducing the centre capacity. True, mine takes up $1\frac{3}{8}$ inch, leaving me capable of turning $3\frac{1}{4}$ inches, and since I made it I did not require so much. In case of an emergency I might use the old one, but that will not, probably, occur for years.

A PHOTOGRAPHIC ENLARGING CAMERA: ITS CONSTRUCTION AND USE.

By CHAS. A. PARKER.

II.—THE ARGENTIC-GELATINO-BROMIDE POSITIVE PROCESS ON PAPER, OPAL AND CANVAS—ARGENTIC PAPER: HOW PREPARED—ENLARGING NOT DIFFICULT—DEVELOPING TRAYS—SPONGE BRUSH—VIGNETTER—EASEL—FASTENING PAPER ON EASEL—TABLE FOR ENLARGEMENTS—DESCRIPTION OF PROCESS OF ENLARGEMENT—FOCUSSING—DEVELOPERS—PROCESS OF DEVELOPMENT—DRYING—WORKING OVER ENLARGEMENT—HINTS ON FAILURES—MOUNTING—ROLLING.

BEFORE describing the actual making of the enlargement, I will just give an outline of the process by which the paper to be used is prepared commercially. Since the invention of the argentic-gelatino-bromide process was first brought to light it has given a great impetus to the photographic trade, because enlarged prints can be produced with an ease and rapidity which seems almost magical to those only acquainted with the old-fashioned methods. Another advantage is that the pictures produced by it are in a high degree permanent, and not liable to fade in a year or two, as is the case with the old collodion transfer, or chloride of silver prints.

The argentic paper, as at present sold, is principally intended for enlargements, and is prepared in the following manner : A smooth and strong paper is selected, and first coated with a preparation of barium chloride, chrome alum, and gelatine, and hung up to dry in daylight. This preparation has the property of becoming insoluble when dry, and forms a substratum which prevents the final sensitizing mixture from sinking in to the pores of the paper. The paper being ready to receive the sensitive coating, is now taken to an apartment from which every ray of daylight is carefully excluded, the only light used being of a deep red, giving it somewhat the appearance of the cell of an alchemist. Here it is stretched tightly on frames, and the preparation which is to render it sensitive to light is applied. This consists of an emulsion of bromochloroiodide of silver in gelatine previously made highly sensitive to light by pro-

longed heating. When coated, the sheets (which are all sizes up to 30 inches by 30 inches) are set aside on levelled benches until the gelatinous coating is firmly set, then they are taken from their supports and carried to a dark-room that is called the drying-room, and hung up to dry. The temperature is carefully regulated to prevent the coating remelting and running off the paper. When dry, the paper is rolled up and packed in light-tight tin cases, which contain twelve, six, or three sheets of paper, and can be purchased by the amateur when making enlargements with the apparatus that I have described. Opal plates and artist's canvases are prepared in the same manner. Through the introduction of this process for artist's canvases, a more correct likeness is obtainable than that which the artist could possibly draw, and vastly cheaper. There is no other process of enlarging capable of giving such good results as can be obtained by this process when properly understood and worked. Chromotype and other carbon pictures have been called "permanent," but their permanence depends on the nature of the pigment employed, also associated with the chromated gelatine in which they are produced. Most of the pigments employed, and generally the prettiest ones, are unable to withstand the bleaching action of light for more than a few weeks. Carbon pictures are therefore only permanent according to the degree in which the colouring matter employed is capable of resisting the decolouring action of light. There is no pigment in an argentic print, nothing but the silver reduced by the developer, after the action of the light from the lantern previously described. That has been shown (by, I think, Captain Abney) to be of a very stable and not easily decomposed nature ; while, if the pictures are passed through a solution of alum after washing and fixing, the gelatine is so acted upon as to be rendered in a great degree impervious to the action of damp, and the pictures are then somewhat similar to carbon pictures without carbon.

Enlarging is by no means difficult, and surely no work need be more pleasing than enlarging from some of the prettiest bits, and hanging them round the walls as specimens of successful work. It is better to begin with the small sizes first, as less paper is likely to be spoilt, and it is easy to go on to larger sizes when fairly successful with the smaller ones.

It will be advisable before going on further to just give instructions for making developing trays, an easel, etc. Good developing trays may be made as follows: four pieces of deal $\frac{3}{4}$ inch thick and $1\frac{1}{2}$ inch deep, are nailed together at the corners, making a frame of any size required (see Fig. 22). A piece of waterproof indiarubber cloth, 2 inches larger all round than the frame, is now taken and tacked round the outside upper edge of the frame, forming a very cheap and durable developing dish. When the dish has been used, the cloth can be taken off, washed, dried, and put away for the next time. The waterproof can be obtained from a dealer in waterproof stuffs in any town for about 3s. 6d. per yard, sufficient for one 30 by 24, one 20 by 24, two 15 by 12's, or two 12 by 10's. Another way of making dishes of all sizes very cheap is to procure some tin or zinc (I prefer zinc), and cut it as shown in Fig. 23. The space within the dotted lines forms the bottom of the tray, and the sides are to be turned up and soldered in the following manner : Take a small soldering iron, or, as it is more properly called, a copper bit, and having bent up the zinc as it is wished to be joined, draw some muriatic acid along on the zinc with a small piece of wood. Now having heated the copper bit so that it will melt the solder easily (it should not be made too hot or it will burn a hole in the zinc), place the point on a lump of sal ammoniac, and apply the solder, some of which will adhere to the copper. Now take the solder and drop a small portion on the proposed joint, draw it along in a fluid state by means of the copper bit, and it will be found that when cold the two parts are firmly united. The superfluous acid should be immediately wiped off the joint with a piece of rag ; and if the trays, when finished, are enamelled with some bicycle enamel, such as "Ardill's Liquid Enamel," 1s. bottle, they will be all that could be desired, very cheap ; and as the sides would be sloping, they can be made all sizes and nested. Fig. 24 represents one of these tray when finished.

A very useful accessory is a sponge brush, shown in Fig. 25, which is made as follows : Take a sponge of close texture, and stuff half or three-quarters of its bulk into a short wide-mouthed bottle ; when it is required to be cleaned it can be pulled apart and the two parts rinsed in clean water. By using a sponge of harsh texture it makes an excellent brush for applying a mountant to the backs of prints, a great advantage being that it never leaves any bristle tracks or sheds them. A few of these brushes about the operating-room will be found very useful for immediately sopping up any accidental spillings.

A vignetter will also be required, and this can be made by cutting an irregular opening in a sheet of cardboard, the edges being serrated, as shown in Fig. 26. The easel is by no means an unimportant part of the apparatus, and the one I am about to describe I have found the best for all purposes, either opal plates or argentic paper. For guidance I will give the dimensions of mine, but it can be made according to the measurement of the largest paper or opal that the operator intends using. Two uprights should first be constructed of some hard wood,

measuring 33 inches long and 2 inches square, and on their inner faces are longitudinal grooves, in which the enlarging screen slides (see Fig. 27); one end of each of these uprights having been dovetailed, they are next mounted on the square baseboard, grooved sides inwards, measurement of baseboard being 24 inches square and 1 inch thick, the two uprights when mounted presenting the appearance of Fig. 28. A perfectly level board is next constructed to slide along the grooves in the frame just described (Fig. 29). Two more pieces, A, B, Fig. 30, are also made to slide along the grooves in the supports of the easel; these are for the purpose of holding opal plates, etc., while enlarging. Two thumb-screws are to be screwed, one on each side of the uprights, for the purpose of holding the easel at any desired height.

The following will be found a good method of fastening the paper on to the easel: Take a strip of brass about 9 inches long, and solder about twenty ordinary pins on to it at equal distances from each other (see Fig. 31). When it is required to attach the paper to the easel, four strips of brass (or more) such as the above are taken, and the paper having been laid on the easel, place one of these strips of brass at the edge of each of the sides, and with a light hammer drive them into the wood to the depth of at least $\frac{1}{4}$ of an inch. Pins pushed in with the fingers are not firm enough, and, also, they do not allow the paper to lay as flat to the easel as it should, which is of great importance, or else portions of the picture would be out of focus.

Having taken so much trouble in making our apparatus and accessories, we ought not to mind making a table to use specially for it, which can be called the enlarging board. At one end of it the enlarging apparatus is placed, and the easel is allowed to slide along the board, being kept in position by the clamps, Fig. 32, to make which, take a sheet of brass $\frac{1}{16}$ inch thick, and cut two clamps of the form of Fig. 32; make four screw holes, and trim the edges with a file, then turn them up to right angles, as shown by the dotted lines, and screw them on to the easel, as shown in Figs. 29 and 33. The enlarging board should measure 6 feet long, 2 feet wide, and 1 inch thick, the height being about the same as an ordinary table. It can easily be made, and needs no further description than to refer the reader to Fig. 33.

Any other apparatus required will be such as is used for every-day work, and therefore needs no special mention here. I will now enter upon a practical description of the manipulations which take place in producing enlarged pictures.

The apparatus must, of course, be used in a darkroom, or rather one in which there is only non-actinic light. We must first satisfy ourselves that all white light has been carefully excluded. A glance at the following table of enlargements (from the "British Journal Photographic Almanac") will determine in a moment the distance of the negative from the lens, and the degree of the enlargement.

TABLE FOR ENLARGEMENTS.

Focus of Lens, inches.	TIMES OF ENLARGEMENT AND REDUCTION.							
	1 inches.	2 inches.	3 inches.	4 inches.	5 inches.	6 inches.	7 inches.	8 inches.
2	4 4	6 3	8 $2\frac{3}{4}$	10 $2\frac{1}{2}$	12 $2\frac{2}{5}$	14 $2\frac{1}{3}$	16 $2\frac{2}{7}$	18 $2\frac{1}{4}$
$2\frac{1}{2}$	5 5	$7\frac{1}{2}$ $3\frac{3}{4}$	10 $3\frac{1}{3}$	$12\frac{1}{2}$ $3\frac{1}{8}$	15 3	$17\frac{1}{2}$ $2\frac{11}{12}$	20 $2\frac{6}{7}$	$22\frac{1}{2}$ $2\frac{13}{16}$
3	6 6	9 $4\frac{1}{2}$	12 4	15 $3\frac{3}{4}$	18 $3\frac{3}{5}$	21 $3\frac{1}{2}$	24 $3\frac{3}{7}$	27 $3\frac{3}{8}$
$3\frac{1}{2}$	7 7	$10\frac{1}{2}$ $5\frac{1}{4}$	14 $4\frac{2}{3}$	$17\frac{1}{2}$ $4\frac{3}{8}$	21 $4\frac{1}{5}$	$24\frac{1}{2}$ $4\frac{1}{12}$	28 4	$31\frac{1}{2}$ $3\frac{15}{16}$
4	8 8	12 6	16 $5\frac{1}{3}$	20 5	24 $4\frac{4}{5}$	28 $4\frac{2}{3}$	32 $4\frac{4}{7}$	36 $4\frac{1}{2}$
$4\frac{1}{2}$	9 9	$13\frac{1}{2}$ $6\frac{3}{4}$	18 6	$22\frac{1}{2}$ $5\frac{5}{8}$	27 $5\frac{2}{5}$	$31\frac{1}{2}$ $5\frac{1}{4}$	36 $5\frac{1}{7}$	$40\frac{1}{2}$ $5\frac{1}{16}$
5	10 10	15 $7\frac{1}{2}$	20 $6\frac{2}{3}$	25 $6\frac{1}{4}$	30 6	35 $5\frac{5}{6}$	40 $5\frac{5}{7}$	45 $5\frac{5}{8}$
$5\frac{1}{2}$	11 11	$16\frac{1}{2}$ $8\frac{1}{4}$	22 $7\frac{1}{3}$	$27\frac{1}{2}$ $6\frac{7}{8}$	33 $6\frac{3}{5}$	$38\frac{1}{2}$ $6\frac{5}{12}$	44 $6\frac{2}{7}$	$49\frac{1}{2}$ $6\frac{3}{16}$
6	12 12	18 9	24 8	30 $7\frac{1}{2}$	36 $7\frac{1}{5}$	42 7	48 $6\frac{6}{7}$	54 $6\frac{3}{4}$
7	14 14	21 $10\frac{1}{2}$	28 $9\frac{1}{3}$	35 $8\frac{3}{4}$	42 $8\frac{2}{5}$	49 $8\frac{1}{6}$	56 8	63 $7\frac{7}{8}$
8	16 16	24 12	32 $10\frac{2}{3}$	40 10	48 $9\frac{3}{5}$	56 $9\frac{1}{3}$	64 $9\frac{1}{7}$	72 9
9	18 18	27 $13\frac{1}{2}$	36 12	45 $11\frac{1}{4}$	54 $10\frac{4}{5}$	63 $10\frac{1}{2}$	72 $10\frac{2}{7}$	81 $10\frac{1}{8}$

The object of this table is to enable any manipulator who is about to enlarge (or reduce) a copy any given number of times, to do so without troublesome calculation. It is assumed that the photographer knows exactly what the focus of his lens is, and that he is able to measure accurately from its optical centre. The use of the table will be seen from the following illustration: A photographer has a *carte* to enlarge to four times its size, and the lens he intends employing is one of six inches equivalent focus. He must, therefore, look for 4 on the upper horizontal line, and for 6 in the first vertical column, and carry his eye to where these two join, which will be at 30—$7\frac{1}{2}$. The greater of these is the distance the sensitive plate must be from the centre of the lens; and the lesser, the distance of the picture to be copied. To *reduce* a picture any given number of times the same method must be followed, but in this case the greater number will represent the distance between the lens and the picture to be copied; the latter, that between the lens and the sensitive plate. This explanation will be sufficient for every case of enlargment or reduction.

If the focus of the lens be twelve inches, as this number is not in the column of focal lengths, look out for 6 in this column and multiply by 2; and so on with any other numbers.

It will be found a good plan to mark on the enlarging board the position of the easel for various sizes

of enlargement, thus saving much time in calculations. One great advantage in making an enlarging board such as I have described, is, that when once the respective positions of the camera and easel are fixed for your favourite size, they are ready for use at a moment's notice, there being no further trouble of focussing; you may also be certain that the easel is at right angles to the axis of the lens, which is of great importance.

Having carefully trimmed and lighted the lamp, remove the cap from the lens, and allow the disc of light to fall upon the easel, to which a piece of white drawing-paper has been affixed by means of the strips of pins previously described. Should the disc of light appear crisp and illuminated evenly to the edges, we may proceed; but if, on the other hand, it appears dull and indistinct, move the lamp by means of the bellows arrangement at the back of the condensers backwards or forwards, until the greatest amount of light that the lens is capable of giving has been allowed to fall on the easel, without an inverted image of the flame being seen.

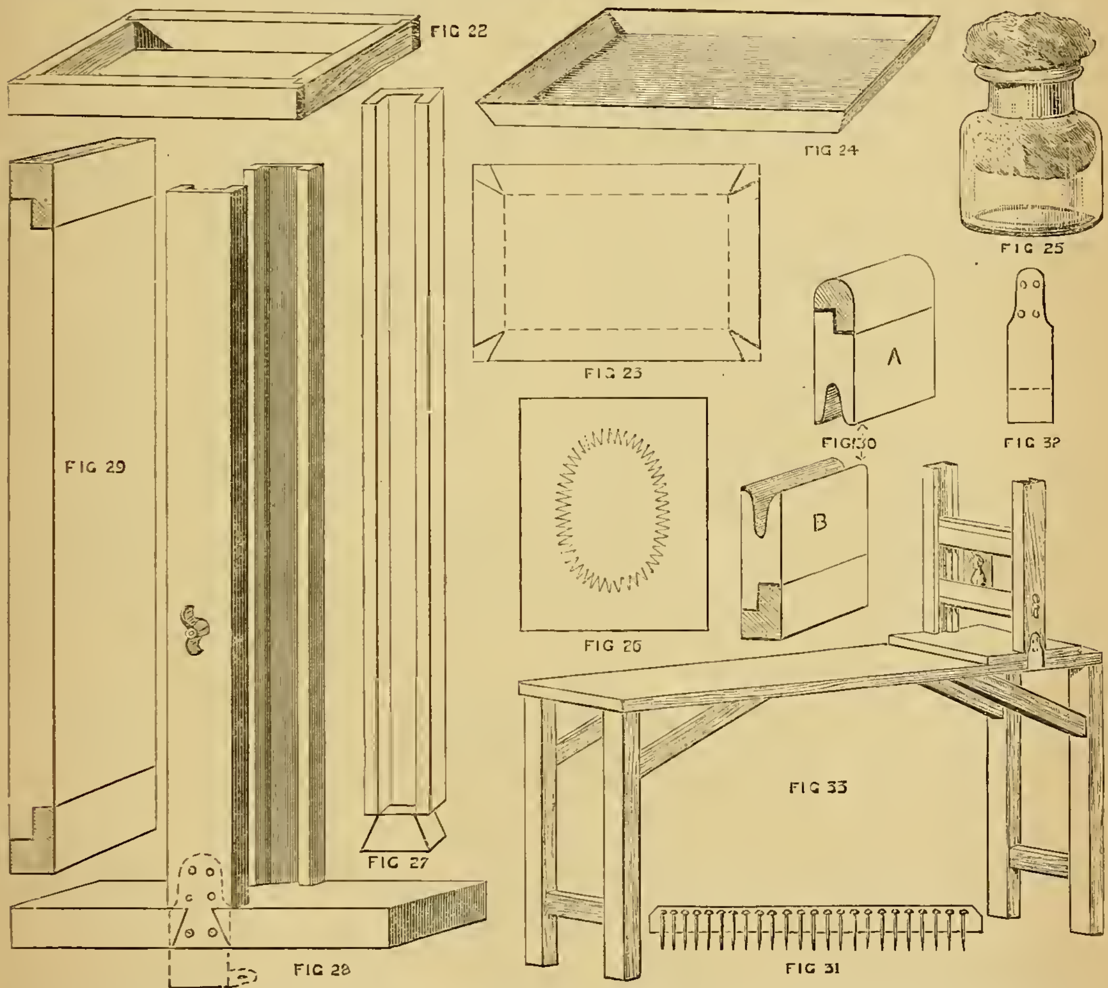


FIG. 22.—DEVELOPING DISH. FIG. 23.—PLAN OF ZINC DEVELOPING DISH. FIG. 24.—ZINC DEVELOPING DISH COMPLETED. FIG. 25.—SPONGE BRUSH. FIG. 26.—CARDBOARD VIGNETTER. FIG. 27.—UPRIGHT OF EASEL. FIG. 28.—UPRIGHTS MOUNTED. FIG. 29.—BOARD TO SLIDE IN GROOVES OF FRAME. FIG. 30.—PIECES TO SLIDE ALONG GROOVES OF SUPPORTS. FIG. 31.—PINS SOLDERED TO BRASS STRIP TO HOLD PAPER TO EASEL. FIG. 32.—CLAMP. FIG. 33.—ENLARGING BOARD, COMPLETE.

Now take a negative, say a quarter-plate or cabinet, and insert it in the carrier upside down, with the film side towards the easel. Place the carrier in position in the camera, and by means of the bellows in front of the negative, and moving the easel backwards or forwards, you will be able to get the image of the desired size, which must be ascertained by measuring. If the picture appears too large move the easel to-

wards the camera, if it is too small move it away. When the image has been obtained of the required size, make a final adjustment by means of the rackwork of the lens (if a portrait combination) or the bellows in front of the negative.

As accurate focussing is of vital importance at this stage of the proceedings, it will be found advisable to have a magnifier in order to ascertain that the greatest possible amount of sharpness has been obtained. The stops should now be inserted; if the lens to be used is a portrait combination, there will be no need to use a stop of less than 1 inch in diameter, and it would be most likely advisable to use the full aperture in the case of dense negatives. But if the negative be very thin a piece of ground glass should be placed behind it; this will be found to equalize the light and greatly improve the picture.

Having carefully performed the operation of focussing, the cap is placed on the lens, the drawing-paper removed from the easel, and a piece of argentic-bromide paper substituted, uncap the lens, and if it is wished to produce a vignette, take the vignetter and keep on moving it excentrically between the lens and the easel, taking particular care not to stop once during the exposure, or it will spoil the picture, a hard outline resulting. A more pleasing effect will be obtained by vignetting portraits, but with landscapes the operator must use his own discretion. No rules can be laid down with regard to the exposure as that must depend on the density of the negative, the lens, the light, and the distance of the lens from the sensitive paper; the exposure will vary from a few seconds to many mintues, but the exact time can easily be ascertained by a few trials on small pieces of paper first, which can be at once developed. The picture having received the correct exposure is ready for development, with any of the following formulæ.

I prefer the ferrous oxalate No. 1, and will select that for demonstrating the development :—

Ferrous Oxalate Developer, No. 1.

No. 1 Solution.

Neutral oxalate of potassium	1 lb.
Boiling water	2½ pints.

No. 2 Solution.

Protosulphate of iron	1 lb.
Citric acid	2½ drachms.
Boiling water	1 pint.

Let it stand to cool. To develope, take of No. 1 4 ounces, to which add 1 ounce of No. 2.

Ferrous Oxalate Developer, No. 2.

No. 1 Solution.

Chrome alum	100 grains.
Boilin water	5 ounces.

No. 2 Solution.

Oxalic acid	30 grains.
Water	5 ounces.

No. 3 Solution.

Neutral oxalate of potassium	4 ounces.
Glycerine	½ ounce.
Chrome alum, solution 1	½ ounce.
Oxalic acid, solution 2	½ ounce.
Water	15 ounces.

No. 4 Solution.

Photosulphate of iron	4 ounces.
Sulphuric acid	10 minims.
Water	16 ounces.

To develope, 3 ounces of No. 3, 1 ounce of No. 4.

Pyrogallic Acid Developer, No. 3.

No. 1 Solution.

Pyrogallic acid	60 grains.
Sulphuric acid	8 minims.
Nitric acid	6 minims.
Water	40 ounces.

First add the acids to the water, then add the pyro.

No. 2 Solution.

Bromide of potassium	240 grains.
Ammonia (880)	4 ounces.
Water	8 ounces.

To develope, No. 1, 1 ounce; No. 2, 2 ounces to each ounce of No. 1.

Clearing Solution, No. 4.

Alum	4 ounces.
Citric acid	1 ounce.
Boiling water	4 ounces.

Fixing Solution, No. 5.

Hyposulphite of soda	4 ounces.
Water	20 ounces.

To Bleach, if Necessary, No. 6.

Sulphuric acid	1 ounce.
Water	100 ounces.

To Harden the Film, No. 7.

Alum	1 ounce.
Water	12 ounces.

The exposed paper after being removed from the easel, should be placed for a minute or two face upwards in a dish of clean water, in order to soften the film, and allow the developer to act evenly, being particular, of course, that no actinic light gets to the picture.

Having decided upon which developer you intend using, it should be mixed in the proportions named, while the picture is soaking. When ready, the paper should be removed and placed face upwards in the

developing tray, and thoroughly drained before the developer is applied, which must be evenly flooded all over the paper at once. Shake the measure slightly before pouring it on, so as to ensure perfect mixing, and then gently rock the tray so as to make it flow over the whole surface. Assuming the correct exposure to have been given, the picture will appear in less than a minute, and will gradually be found to gain the proper amount of density, and should be fully out in four or five minutes, and the picture will appear with all the proper gradations of light and shade possessing after fixation all the colour of a good engraving.

It should be removed from the developer as soon as the proper amount of strength has been obtained, as it will appear a slight shade darker after fixing. The development should be stopped by pouring off the developer back into the measure, and flooding the tray with clean water ; now wash the picture under a vigorous stream from a tap provided with some contrivance for spreading the water, a rose such as is used for garden syringes will be found to answer very well, and then place it in the *clearing solution*, *No.* 4, for the space of about two minutes, then take it out and slightly wash and place in the *fixing solution*, *No.* 5, in which it should remain for about four or five minutes, when it may be examined in *daylight;* and if the whites are pure, and the lemon colour of the bromide of silver has entirely disappeared, the paper is fixed ; but in order to be quite certain of this, it will not hurt to leave it in for a few minutes longer. If the hypo solution is not too strong, ten minutes or a quarter of an hour will do no harm, then remove, and again place it in the clearing solution for another two or three minutes, in order to harden the film, when it should be withdrawn and placed to wash under the tap for half an hour ; or if this is inconvenient, let it soak in a dish of clean water for an hour, then take it out, and lay it on a glass plate under a flow of water from the tap, and gently dab it on both sides with the sponge brush, then return it to the dish of water, and again repeat the sponging process at three intervals of an hour each. By this simple means the hypo will be entirely eliminated, and the picture can be hung up by the corners to dry, being careful to keep it from dust. The drying will take about four hours, but if the picture is required in a hurry, it may be well drained, and placed in methylated spirit for three or four minutes, and then hung up to dry, which will take about a quarter of an hour.

If my instructions have been well attended to, the result will be equal to a splendid carbon enlargement, free from spots or blemishes, and may be mounted or framed without a single touch. But should the picture be of a yellow tint when dry, it indicates under-exposure, and will require to be again wetted and placed in the *bleaching bath*, *No.* 6. This will remove all yellowness, and leave the picture of a pure tone ; and after again washing and drying it will be ready for mounting. If the picture requires it, the densest portions may be touched up with a little Indian ink and gum water, or it may be finished in oils, water-colours, or crayons, according to the taste and requirements of the operator ; if it is intended to be finished in water-colours, it will require a final bath of *alum*, *No.* 7, then dry spontaneously. By this method the gelatine film will be rendered in a great degree waterproof, thereby taking water-colours without swelling or blur.

For working over the enlargement nothing is better than a small piece of soft felt, using it in the same manner as a stump. A fine stippled surface may be got in this way, on account of the texture of the paper taking up the colour unequally, being especially useful for all kinds of retouching, and for putting in clouds it will be found much better than water-colours. Various tints can be got by using powdered crayons of different colours.

A word or two as to the failures likely to be met with in enlarging on argentic paper. If the image has been over-exposed, it will be found to flash out quickly, and rapidly become dark all over, the picture appearing as though seen through a mist, and likewise destitute of any artistic qualities at all. If on the developer being applied signs of over-exposure are perceived, pour it off quickly, and wash the paper; then make up a fresh solution with less iron. Often by this means a good picture may be obtained in spite of a little over-exposure. Under-exposure is indicated by a sluggish development, and may be to a great extent remedied by adding a little more iron to the developer. If you intend to do this pour the developer back into the measure, and very cautiously add a *few* drops of iron, and then return it to the developing dish. This will have the effect of stimulating it ; but on no account add too much iron, or the yellow compound salt will be more in suspension than solution, and, in the course of development, will be deposited upon, and at the same time formed in the gelatinous film, thus causing a yellowing of the whites of the picture. The use of citric acid in the developer will to a great extent prevent the iron from depositing. It will always be found best to give the correct exposure, for if the picture developes slow and has to be forced, the paper becomes yellow, and the resulting picture is poor, but this may be remedied to a great extent by the bleaching solution. I strongly recommend that the ferrous oxalate developer should be used, and mixed fresh for every batch of enlargements, as it decomposes very rapidly. The alum bath

should be fresh, and should on no account be used day after day, for if it is old and discoloured it will be certain to destroy the purity of the whites, thus spoiling the work. The hypo bath should be new and quite clear, and must not have been used previously for any purpose. The paper should be allowed to remain in the hypo for eight or ten minutes after it appears fixed, or else imperfect fixation will cause discoloration of the whites. If the picture appears grey and flat, it has been under-exposed, or any tendency to yellowness, or intensely black and white, denote under-exposure. Almost the only other defects or failures likely to be met with are traceable to want of cleanliness in handling the paper. The paper can be exposed wet. To do this soak it in a dish of cold water, remove and lay on a sheet of plate glass, to which it will firmly adhere, taking care, of course, not to crease it, also being particular that it lays flat. If it is decided to expose the paper in this manner, the image must be focussed upon a sheet of white paper treated in precisely the same manner, which is then removed and replaced by the sensitive paper.

If it is intended to mount the enlargement on cardboard, the following mounting medium will be found the best, as it does not cause the print to cockle. Procure an earthenware jar with a cover to it, such as a salt jar, and into this put 100 grains of Nelson's photo gelatine, then add 2 ounces of water, leaving it to soak for three or four hours, and then pour off all the water, the gelatine will be found to have swollen very much ; now pour a dessertspoonful of boiling water over it, place the jar in a saucepan of boiling water, and hold it over a flame, and keep stirring it until the gelatine is dissolved. Then add cautiously to the solutiom, which should he boiling, 5 ounces of methylated spirits, a very small quantity at a time, continuing the stirring all the time. If any white scum should form, wait till it has dissolved before adding more spirit. When all the spirit has been added, the solution should be allowed to boil till it is quite free from any scum, and of a clear amber colour ; it can now be poured into a wide-mouthed bottle for storing ; and for use stand the bottle in hot water until quite liquid, and apply sparingly by means of a sponge brush.

If the amateur does not possess a rolling press, an ordinary mangle or wringing machine may be easily made to answer the purpose. Procure a sheet of tin plate the width of the rollers of the wringer or mangle, say 20 inches by 20 inches, trim the edges and corners with a file, and rub it clean and dry with a soft rag. Apply the above mountant to the picture as thinly as possible, then lay the picture in position on the mount, and on it lay the tin plate, clean side downwards, then put it between two pieces of cardboard the same size as the tin plate, and pass it all through the rollers of the mangle two or three times, it will then be found as flat as if it had been passed through a proper photographic rolling press.

Should it happen that the picture is likely to adhere to the tin plate, rub it with a little French chalk, by this means the mounting can be very rapidly and easily accomplished without damaging the picture. Adhesive mounts are used in America, the print being damped is pressed on the mount and allowed to dry, it is then burnished with considerable heat and hard pressed. This can, I am told, be accomplished by coating cards with a strong mucilage of gum tragacanth, allowing it to dry, and then damping the print and laying it on the adhesive mount, and finally passing it through a rolling press.

(To be continued.)

MY FRETSAW MACHINE, AND HOW I MADE IT.

By JOHN HENDERSON.

AS I have noticed from time to time questions from correspondents with regard to the method to be adopted in converting the table of a sewing-machine into a fretsaw machine, I send you a sketch of one that I have made myself, using the table of an old sewing-machine as the base of my operations. I hope my sketch and the following description will be intelligible to all who read it, provided that it is considered to be of sufficient merit to find a place in AMATEUR WORK. It will be seen that I have acted up to the advice that has been repeatedly given by writers in "our" magazine—namely, to contrive according to the materials that we happen to have on hand. If there is any shortcoming or anything that is not perfectly clear in the description of my machine and the way I went to work to make it, I trust I shall be held excused when I say I have had but little, if any, education, as have been in the coal mines ever since I was ten years old. I can only say that the attempt to describe and draw it has given me far more trouble and vexation than it did to design it and fit it up.

The table of the stand is represented at T T, in Fig. 1, which exhibits the front elevation of my machine. The place in which the sewing machinery worked is taken out and closed with a bit of hard wood, in which a hole for the saw is made. A bar of wood, A A, $\frac{}{8}$ inch square, is raised 5 inches above the surface of the table top, and supported by

side-pieces, B, B. These uprights are screwed, as will be easily seen from the sketch, to two blocks of wood, X, X, $2\frac{1}{2}$ inches square, which are themselves fastened to the bottom of the table-top at each end by screws entering them from above through holes drilled in the table-top. In the middle of the bar A A, at K, a hole is bored, into which is screwed a small nipple of a bicycle wheel spoke. In the head of a common bracket fretsaw frame above the saw clamp P, I drilled a small hole with an Archimedean drill, into which I fixed a piece of stout knitting needle, $3\frac{1}{2}$ inches long, which works in the bicycle nipple shown at K. The bar of wood, N N, is $2\frac{1}{2}$ inches wide and $1\frac{1}{2}$ inch thick, and is screwed at each end to the blocks X, X. In the middle of the bar, N N, a groove is made for the under guide. This I made out of an old bicycle treadle, but any piece of brass or iron tubing would do as well. The tube of the treadle I plugged tightly with hard wood, and then bored a hole into each end of it: in the top hole I fixed the tang of the bracket frame, after I had knocked the handle off, and in the under hole I fixed a piece of beech-wood to act as a crank connection. In the middle of the treadle tube I drilled a small hole and fixed a bit of knitting needle into it, letting the knitting needle stick out about three-quarters of an inch on each side, so that it could slide upon two other pieces of knitting needle fixed to the bar N N in an upright position, which will be better understood by looking at Fig. 1, from which it may be seen that the treadle plates shown at L, L, are made use of to keep the tube in position against the upright pieces of knitting needle, after the holes in them are a little enlarged so the tube will work through them.

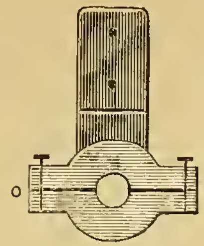


FIG. 2.—SIDE VIEW OF ATTACHMENT TO CRANK.

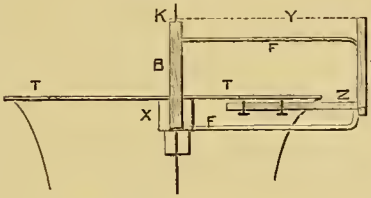


FIG. 3.—SIDE VIEW OF GUIDE FOR STEADYING SAW ARMS.

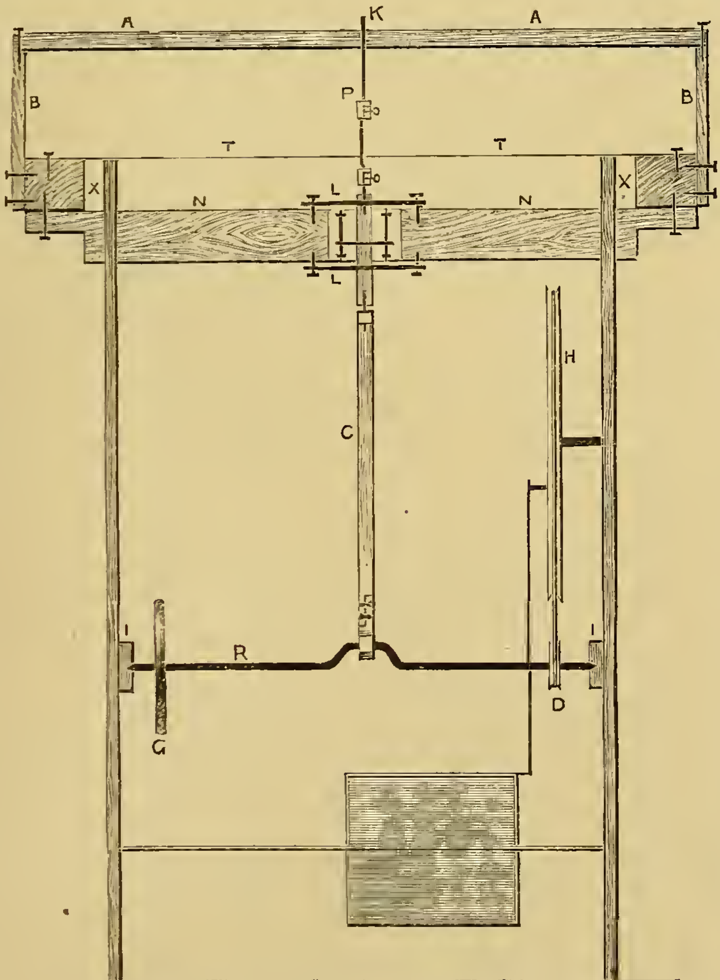


FIG. 1.—FRONT ELEVATION OF FRETSAW MACHINE MADE FROM SEWING MACHINE.

The crank spindle, R, is made of oak, with a piece of leather glued round it where the crank C fits to it. At each end of the spindle a piece of brass tubing is fixed on, and two pieces of beech, I, I, are screwed to the bars of the stand, with holes in them for the spindle to run in. The holes are bored only half-way through the wood. The piece which connects the upright crank with the spindle is made of beech. It, first of all, has a hole bored through it to fit the spindle, and after the hole is bored it is worked to the shape shown in Fig. 2, which represents a view of this part of the machine when viewed from the side, or, in other words, its side elevation. When this is done it is cut with the fretsaw right across the centre of the hole, as indicated by the line O O. The two parts are then put over the bow of the crank spindle, and fastened together by two screws, and the upper part is connected with the

crank, C, by two screws, the ends of the pieces being halved so as to drop into one another and form, as it were, a continuous connecting rod. A balance wheel, G, 9 inches in diameter, is placed on the spindle R to the left, and to the right a small pulley wheel, 3 inches in diameter, round which, and the driving-wheel H, is the driving belt or cord. The driving-wheel, H, and and the treadle are left untouched, and remain precisely the same as they were in the machine when it was a sewing machine.

In Fig. 3 is given a side view of a guide, which I have for steadying the saw arm or bracket at the back. The guide itself is shown at M*; Z is merely a piece of wood underneath the table, and of sufficient length to bring the upright M close to the back of the bracket arm, the top and bottom of which are shown at F, F. K is the knitting needle, which is fixed in the head of the bracket frame above the saw clamp. The clamps themselves holding the saw being hidden in Fig. 3 by the block X and upright B.

If the guide M was made of iron, and reached forwards to K, with a hole in it for the knitting needle to work in, the bar A A, shown in Fig. 1, would not be required. The dotted line Y indicates what I mean. I tried a wooden one, but found it was not rigid enough. The under guide, instead of being made of a bicycle treadle and knitting needle, would be much better made with a square steel rod working within a steel square.

* This, as shown, is not very clear, but I imagine M is either grooved for the arm to work up and down in, or that it is uble, *i.e.*, two rods between which the arm works.—ED.

THE REFLECTING TELESCOPE:

ITS CONSTRUCTION AND MANUFACTURE.

By EDWARD A. FRANCIS.

XII.—DETAILS OF SIMPLE METHOD OF MOUNTING INSTRUMENT.

VERY many years ago, the son of an American portrait-painter, having heard or read of the old method of making metallic reflecting telescopes, begged for his father's help to cast a speculum for a little telescope he would have made. The father gave the required help, relinquished portrait-painting as a profession, and, instead, began to study the manufacture of telescopes. He was over forty years of age when first he practised the art, yet he became the most eminent optician of America, and one of the greatest in the world—Mr. Alvan Clarke.

Twelve months have elapsed since first the writer had the pleasure of addressing his readers in these pages. The actual making of the great speculum of a reflecting telescope has been completely considered. Yet a glance back through some of the latter papers is likely, as was before suggested, to dissuade the amateur with only a very modest trust in his own powers, from attempting the manufacture of an instrument, the construction of which is apparently so full of difficulties. To him we would say: "Disregard, if you please, the theoretical papers (except the first) altogether. Follow out only those practical chapters which simply explain the method of working. Work honestly, truly, and carefully. Polish your mirror (without testing, if you will) upon a polisher one-half of an inch greater in diameter than the speculum itself, following rather the footsteps of Mr. Mudge than the more modern method. Mount the speculum so constructed in the manner just about to be described. The result of its direction to the surface of the moon, even if the speculum be unsilvered, cannot fail to inspire you with a confidence in your own powers, and a longing for greater excellence of workmanship, which will send you back with renewed vigour to master those theoretical papers, the study of which alone can ensure complete success." This to the faint-hearted: the true amateur will need no such address.

As this paper is being written, the thermometer registers 80° in the shade, and folks are assuring each other that it is the hottest day they have known. Such weather puts the astronomer almost out of work: the nights are so short and light, and the face of the sky, comparatively speaking, is so uninteresting. But by the time this reaches the reader in print, things will have changed—for the better for our amateur astronomer, for the worse for most other people. November will bring with it short days, and, perchance, cold, at any rate, long nights. The giant planets will be gracing the midnight sky with their presence, while Orion, the matchless constellation of the heavens, will be rapidly attaining a position that will throw its beauties open to the English observer. So we must hasten on with our instructions, that the amateur may not have to wait another long year for a glimpse of the chief beauties of practical astronomy.

We shall, therefore, not consider in this chapter the making of the small plane reflector.*

That mirror, which in our case will have a surface scarcely two square inches in extent, will require to be prepared with the same accuracy and patience which was before bestowed on the preparation of the principal speculum. For the labour of forming its optically flat surface, the professional telescope maker demands about twenty shillings per inch for small "flats," and

* See Chapter I., page 9, Fig. 7, where the general arrangement of the mirrors of a Newtonian reflector is shown.

a higher rate as they increase in size (the measurement being taken across the minor axis of the elliptical mirror). Notwithstanding this, it is unhesitatingly advised, that those of my readers who can conveniently spare a sovereign for the purchase of a professionally worked flat, should do so. There is a risk that *neither* of the mirrors may be perfectly constructed, but, if the experimenter be confident that the smaller speculum *is* perfect, he may immediately set himself to discover the error in the greater speculum. If, on the contrary, he cannot vouch for accurate workmanship in either case, he may be for some time at a loss to decide which of the specula it is that is incorrectly figured. My duty here, however, to my readers, is to place at their disposal such instructions as shall enable them to personally construct each separate part of the instrument. Therefore, though we shall not consider here the process of manufacture of an optically flat surface, we shall do so in another paper, where a simple method of testing shall be taught, by which the amateur may discover if his workmanship be perfect or not; and if not, how to detect by actual experiment which of the two specula may be the cause of any defect.

Two courses then are here open to us. The first is to purchase the small mirror completed; the second, to cut the oval glass required from the best commercially polished plate glass that can be procured, and use it temporarily without further treatment. In pursuing the latter course, the amateur will not be desecrating the traditions of practical optics so much as might be at first thought. Dr. Draper, of America, for some time, used in his great telescope such a piece of glass—of no less than five inches in its major diameter—not specially prepared, but cut from the centre of a large looking-glass, which had been accidentally broken.

The Rev. Cooper Key and other gentlemen amateurs on *this* side of the Atlantic, have also left it on record that during preliminary experiments they have resorted to the same device. The reason why this glass *may* perform well will be at once discovered if the reader will investigate the method of its manufacture, when he will find that the grinding and polishing of plate glass, even on a wholesale scale, is a more delicate operation than is commonly imagined; each sheet being specially ground and polished by experienced artificers.

It will be seen, by reference to the diagram referred to in the footnote, that the plane mirror C has its silvered surface placed at an angle of 45°, with the axis of the greater speculum or with the side of the tube. It will also be noticed that the light, after reflection from the great speculum, forms a cone, which is cut by the "flat," as the small plane mirror is technically termed.

A cone cut across near to its apex in the manner indicated in the diagram, must, as will be seen from the little sketch, Fig. 72, present an elliptical or oval section, and a flat, which would reflect all the light of the cone and yet have no superfluous surface, must be of such a shape. Therefore, the small mirror is not cut to a circular plan, as the greater speculum was, but to that of an ellipse having its major to its minor axis, as seven is to five, as shown in Fig. 73, which is a sketch of a completed unsilvered flat, for a telescope having a concave speculum 6½ inches in diameter and 5 feet in focal length.

Having procured several pieces of glass, rather larger than Fig. 73, and cut, if possible, from near to the centre of a sheet of best polished plate glass, the telescope maker may proceed to reduce them to the required shape; and this can be done, to a certain extent, with a good diamond. The glass may, however, be conveniently nibbled to the required shape by the aid of a small parallel vice or screw-hammer. A little practice with a piece of waste glass will very soon indicate the method of proceeding. The jaws of the vice or hammer should not hold the glass at all, but simply fit it loosely, when by an upward or downward pressure the edge of the glass may be crushed, as it were, away. The instrument used by the trade for this purpose is known as a pair of "shanks," and consists of two rods of soft iron about half an inch square and 7 or 8 inches long. These rods are loosely pivoted together at one end, and at the other are provided with handles, so that they present the appearance of a long pair of scissors without any blades. The glass is nibbled away by these exactly as it would be between the jaws of a vice. Having roughly brought the glass to shape, it is then edged in a manner precisely similar to that previously described for the larger speculum: but it will be seen by reference to Fig. 74, that its edges are bevelled off, in order that it may be truly fitted into the brass tube that forms its mount. How to obtain this exact bevel will be shown.

A rod of wood, 6 or 8 inches long, is turned up in the lathe to a diameter equal to, or slightly less in length than the minor axis of the ellipse of the intended flat. Around this rod (while in the lathe) and near to its centre, two lines should be marked exactly as far apart as the rod is thick. The rod should then be cut across from one line to the other at an angle of 45°, and the roughly-cut glass cemented with resin or hard pitch between the two pieces A and B (Fig. 75) so obtained. When returned to the lathe, if the wood and glass have been properly cemented together, the latter may be cut to a shape precisely similar to

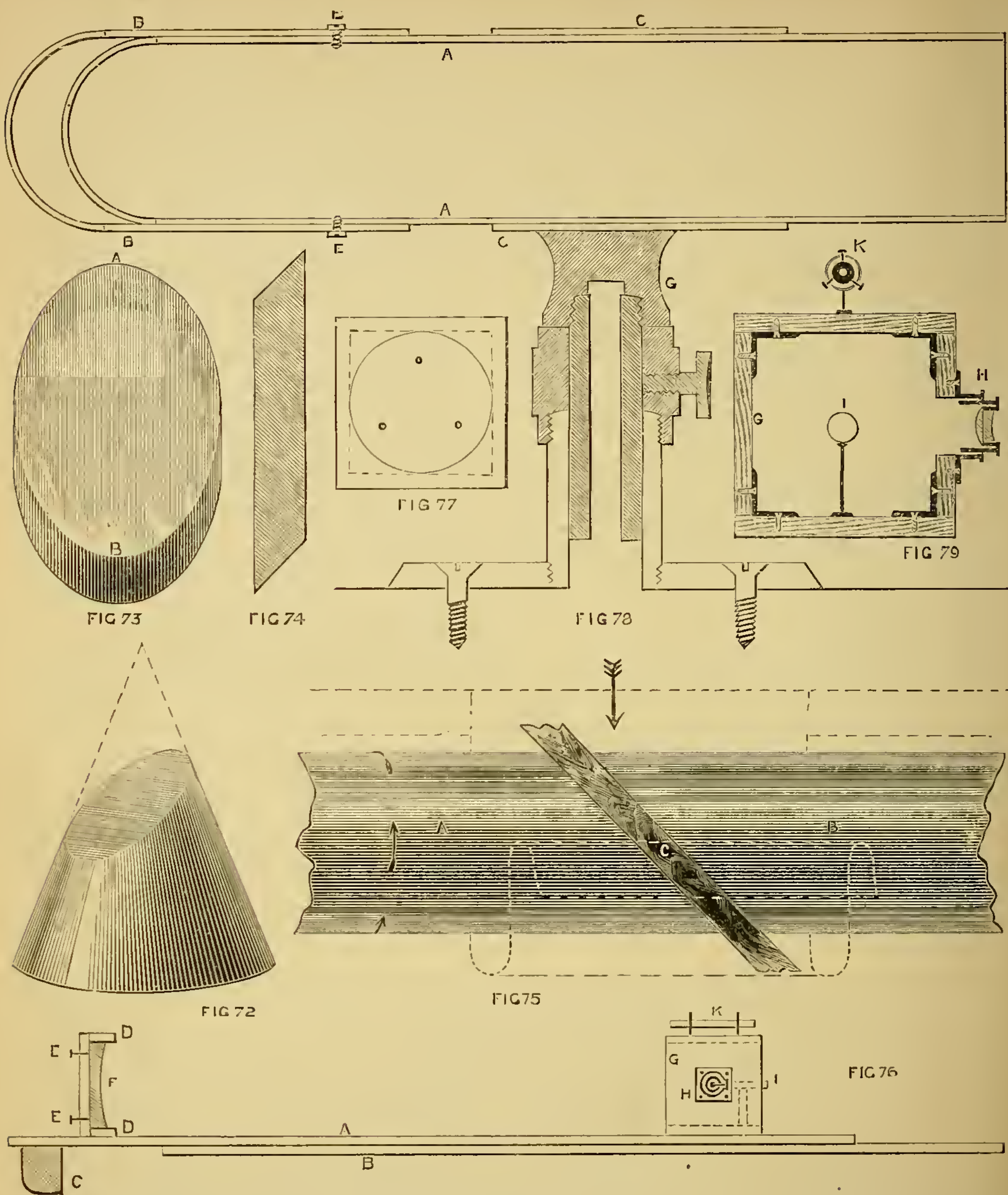


FIG. 72.—DIAGRAM SHOWING SECTION OF CONE AT RIGHT ANGLES TO AXIS TO BE AN ELLIPSE. FIG. 73.—SKETCH OF COMPLETED UNSILVERED FLAT FOR 6½ INCH REFLECTOR—FULL SIZE. FIG. 74.—SECTION OF FIG. 74 ALONG MAJOR AXIS A B, SHOWING BEVELLED EDGES. FIG. 75.—MODE OF MOUNTING ROUGHLY CHIPPED GLASS FOR SMALL FLAT MIRROR TO CUT EDGE TO PROPER BEVEL—A, B, Portions of Wooden Rod Mounted between Lathe Centres; C, Flat Cemented between A and B. FIG. 76.—TELESCOPE ROUGHLY MOUNTED—A, B, Foundation Boards; C, Block to raise Mirror Cell; D, Mirror Cell or Box; E, E, Adjusting Screws; F, Speculum; G, Box covering Flat Mount and carrying Eye-piece Finder; H, Eye-piece; I, Flat Mount; K, Finder. FIG. 77.—BACK VIEW OF MIRROR CELL, SHOWING POSITION OF ADJUSTING SCREWS. FIG. 78.—SECTIONS OF FLAT MOUNTING. FIG. 79.—BOX CARRYING EYE-PIECE AND FINDER—G, Box; H, Eye-piece Mount; K, Finder.

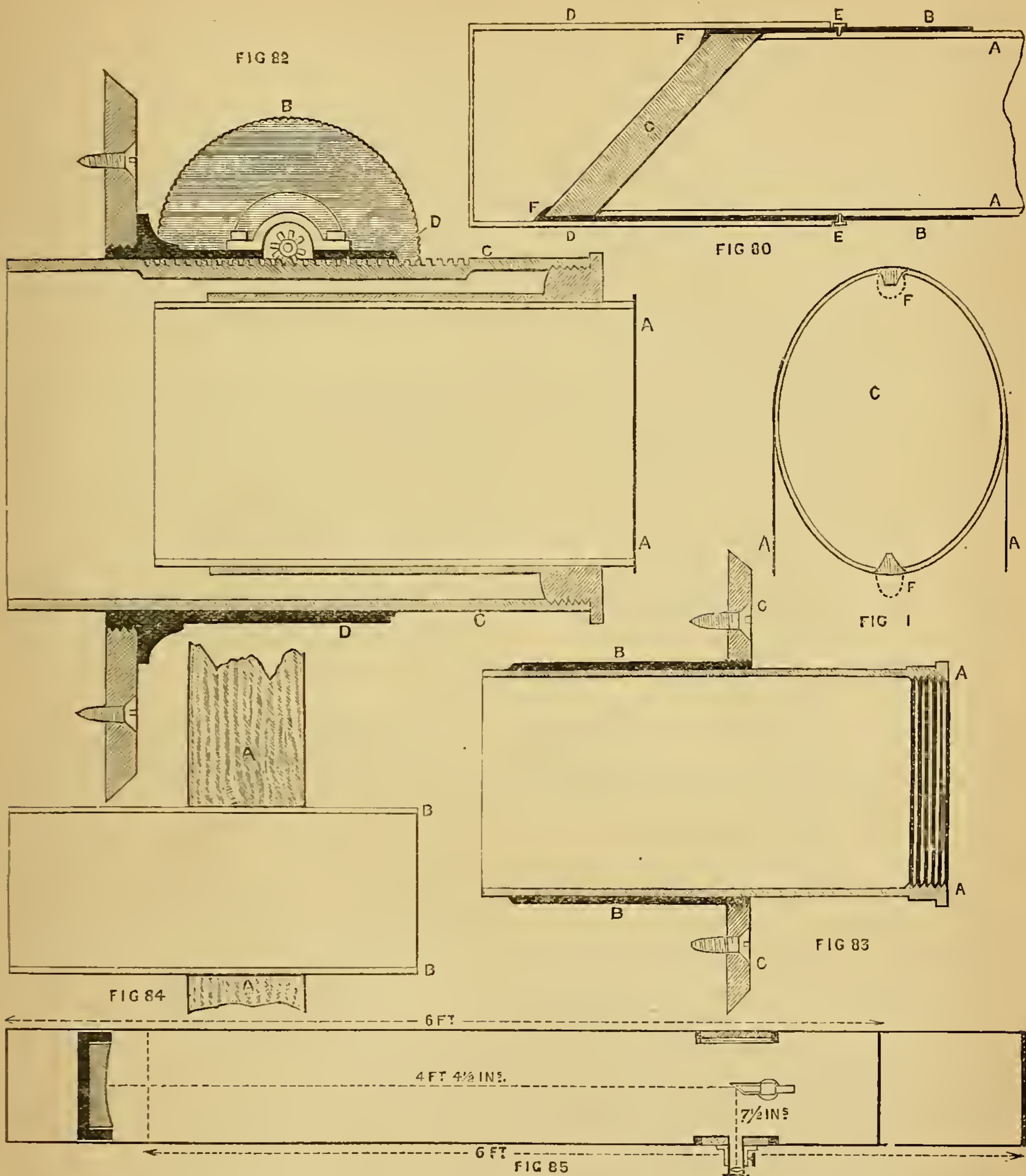


FIG. 80.—MOUNTING FOR SMALL MIRROR—A, Inner Tubing; B, Outer Tubing accurately fitting round Flat and Inner Tubing; C, Flat; D, Projecting Cap. FIG. 81.—DIAGRAM SHOWING HOW BRASS TONGUES F, F, SOLDERED ON TO INNER TUBING A, A, ARE TURNED DOWN TO PREVENT MIRROR C FROM SLIPPING OUT. FIG. 82.—RACK-WORK FOCUSSING APPARATUS FOR EYE-PIECE IN SECTION. *Note.*—The Eye-piece is carried in Inner Tube A, A; the focussing is performed by turning Milled Disc B, when Tube C, C, operated by means of Rack and Pinion, moves within Fixed Tube D D. FIG. 83.—SIMPLE SLIDING TUBE ADJUSTMENT FOR EYE-PIECE. *Note.*—Tube A, A, carrying Eye-piece slides within B, B, attached to Telescope by Collar C, C. FIG. 84.—SIMPLEST METHOD OF FIXING EYE-PIECE—A, A, Wooden Disc pierced in centre to receive Tubing B, B, which carries Eye-piece. FIG. 85.—DIAGRAM SHOWING RELATIVE POSITIONS AND DISTANCES OF GREATER AND LESSER SPECULA AND EYE-PIECE.

that indicated in Fig. 73 and of any required size. In the absence of a lathe, a rod of the requisite diameter may be easily obtained, marked and cut, and the glass being cemented between the two pieces may be edged by grinding on an ordinary grindstone.

In the lathe the soft iron band which was used to trim the disc of glass for the large speculum, may be dispensed with, a band of stout sheet tin or copper being substituted for it.

To prevent chipping during the grinding, it is advisable that two or more flats should be cut at the same time, the glasses being cemented together with *Canada balsam.* If three discs are cemented together, namely, A, B and C, B being centrally placed, it is evident that any chipping during the rough grinding would take place at the outer edges of A and C, while B would remain whole. There is no reason why A and C, under such circumstances, should not be of common glass and simply used as shield to the true flat cemented between them.*

In describing a rough mounting, it must be understood that the form suggested may be varied as circumstances and the materials at hand demand. It is my opinion that there are really only two methods in which it is worth while to mount reflecting telescope. The one is, to mount it in the manner first about to be described, on a plank; the other, to mount it thoroughly on properly-turned bearings, with a heavy counterpoise weight. In the first case, one is prepared to experience great obstacles to complete ease of observation, and is, consequently, also prepared to encounter and overcome them. In the latter case, comfort is assured. But if any intermediate style of mounting is aimed at, the prospect of easy observation is encouraged only to meet with a tantalising disappointment.

A tube (commonly considered an indispensable part of every telescope) is not necessary to fine definition. Good work has been done and good instantaneous photographs of the moon obtained with specula mounted on a stand similar to that illustrated in Figs. 76 *et seq.* The fact of these papers being written for the instruction of all those who are determined, by necessity or choice, to construct the telescope for themselves, sufficiently justifies the action of the writer in suggesting a comparatively crude contrivance which shall enable them to test their handiwork by practical application, meanwhile the proper mounting is in course of preparation. The experience gained in the arrangement of a primitive form of mounting is peculiarly necessary to him who would construct or have constructed for him, the more advanced machinery.

The base then consists of two boards (Fig. 76), each 6 feet long, one inch or more in thickness, and about 9 inches wide. Sound, seasoned, and screwed together by as many screws as may be thought necessary, they should not be afterwards found to warp to any appreciable extent. The general arrangement of the parts in their relation to each other will be evident from a study of Fig. 76. At that end of the base which supports the mirror F in its cell D, is screwed a block of wood C, some 3 inches square and 8 or 9 inches long, its purpose being merely to raise the mirror cell and its adjustments from any danger of disturbance when fixing the instrument into position.

The mirror cell, D D, may consist of a square box (shown in section in the diagram) of such a size that the speculum may be easily removed from and placed in position. It may be made of wood about one inch thick, the speculum resting in it upon a bed of several thicknesses of thin flannel or of felt. The back should be pierced by three thumb-screws, occupying the positions indicated in the plan, Fig. 77. These thumb-screws serve to adjust the speculum, as it will afterwards be found necessary to do. The cell must be fixed perfectly vertical to the base-board; and, moreover, at a right angle with the edges of that board.

A simple method of mounting the smaller mirror is shown in Fig. 78. The flat having been cut to the required size, a visit to the brassfounder's should be made, for the purpose of procuring a length—say, 8 or 10 inches—of best tubing, of such a size that the flat will easily fit inside. Great care must be taken in the fitting; indeed, a dummy flat should be used, for if once the glass becomes fixed in a piece of tubing too small in diameter or ill-shapen, it is certain to be badly chipped in the attempt to withdraw it. Having selected a length of tubing of the necessary size, a second length of a smaller size, which will exactly fit and slide within the former, should be obtained, and a short length (two or three inches) which will fit outside of all. So that we have three sizes of tubing. The first of an external diameter equal to the minor axis of the flat; the second, of such a size as will exactly fit over the first tubing; the third (a short length) which will fit over all.

The stouter, but narrower tubing, which is to form the support of flat and mount, a modified form of which may be purchased ready made, will not require any farther explanation than that given in the diagrams. The thumb-screw F, which secures the inner tube in position, may be dispensed with, if the fitting of the inner into the outer tube, is perfect

* The glasses can be separated when finished, by carefully ~~beating~~ them and the superfluous cement removed by the aid of methylated spirits.

— Treating

enough to cause the former to remain in any position in which it may be placed.

The mounting may be done without the aid of a lathe.

Take the tubing smallest in diameter and cut from it a length of not less than six inches; it will be seen from the figure that the actual length within an inch or so is immaterial. Cut or file one end of it straight across, and the other end (A, Fig. 80) to an angle of 45°. This forms a base upon which the flat may rest, and if it has been accurately done, the oval glass when placed upon it, would appear so far as dimensions are concerned, a mere extension of the tubing But the flat would fall off; to prevent this, a length of two or three inches of the tubing second in diameter, should be cut in exactly the same manner, and slipped on over A A, so as to form a little wall of brass all around the flat, see Fig. 81. If then, two little slips of brass, F, F, be soldered on to B B as indicated, to prevent the glass slipping out in front, it will be found that the little mirror will be securely held in position. The respective tubes are secured by the small screws, E, E.

A second length of the tubing B, about 2 inches long, should then be cut flat at each edge, and soldered, as shown, to the little casting G, which should have been previously prepared with a circular file to a proper curve. The apparatus shown in Fig. 78 will then have been completed; it only remains to solder on to one end of the short length of tubing which fits over all, a small brass disc making an air-tight joint, and we have the protecting cap, D D, Fig. 80, to slide on when the telescope is not in use.

There are several defects in this arrangement, which we could not tolerate in a perfectly mounted instrument. For example, the adjustments necessary are obtained by sliding or rotating the tube A, carrying the flat, inside the short tubing C, consequently, the placing on of the cap, D D (Fig. 80) would throw all out of adjustment. But, in any case, a fresh adjustment would be necessary in such a rough and ready mounting for each new series of observations, and so easily can it be done, that it is not advisable to secure stability at the expense of complication, by making of the small length of tubing, C C (Fig. 78), a split collar actuated by an adjusting screw. The adjustments necessary, as will be afterwards shown, are of extreme simplicity.

The next point of consideration is the box, which carries finder and eye-piece. As will be seen, it is simply a neatly-made square box, open at two opposite sides, and of the same external dimensions as the mirror cell. It is shown in section in Fig. 79, where G is the woodwork—H, the rackwork arrangement for carrying the eye-piece—I, the flat mounting—and K, a finder; the latter of which we will soon separately describe. The box is shown in the diagram strengthened with interior brackets.

For the focussing apparatus for the eye-piece, there is nothing more easily adapted than the brasswork of an old-fashioned half-plate photograph lens, which can be obtained from any dealer in optical sundries for two or three shillings, while to have a similar one made would cost at least ten shillings. It is illustrated in Fig. 82.

Should it be found impossible to obtain such a piece of apparatus, an ordinary length of tubing one inch and a half in diameter, and working in a brass collar, as in Fig. 83, may be substituted, or, as a last resource, the tubing may be worked in a well black-leaded circular aperture in a small square piece of hard wood, as suggested in Fig. 84.

The relative positions of the various parts will be readily seen from Fig. 85, and with that figure we must close this chapter.

(*To be continued.*)

COLD SOLDERING, BRAZING, AND METAL INLAYING.

By GEORGE EDWINSON.

PERSONS only slightly acquainted with the art of electro-deposition, and having only a small knowledge of the chemistry of metals, at times fondly hope to effect a revolution in practical metallurgy by the discovery of a process for uniting metals firmly to each other by means of acids, electricity, or some other agent than fire. Skilful metal-workers have also given the subject their close attention, and have stimulated the hopes of others by their partial successes; but cold soldering and brazing is at best only a "will o' the wisp" to those who seek by its aid a perfect substitute for the process of soldering and brazing by heat in the ordinary manner. If a good sound joint has to be made in metal work—a joint that will stand wear and tear, blows and strains, such as the seam of a copper or brass boiler or pipe, or the cog of a wheel, or the joints of a bicycle—we must have recourse to the old method of uniting the parts by the agency of fire, since none other will make it equally strong. I write thus to prevent sanguine amateur metal workers from wasting their time and material in attempting to apply any of the processes hereafter described, where heat alone should be employed. Some of the processes have been invented to meet cases of necessity, and others have been discovered whilst searching for other things,

whilst all may be said to have their use in a circumscribed sphere of special application.

Cold Soldering.—The following processes were published by Mr. Thomas Fletcher, *of Warrington*, in *Design and Work*, Vol. IX.

Cold Soft Solder.—The solder is prepared in the following manner: Dissolve one ounce of copper sulphate (blue vitriol, or blue stone) in one quart of water, in a jug or basin; into this place zinc rods, or large pieces of scrap zinc. After some time, the acid in the copper sulphate will have combined with some of the zinc, and an equivalent of fine metallic copper will have been thrown down on the zinc and on the bottom of the vessel. When the zinc has ceased to throw down any more copper, and the green liquid has been decolourised, take out all the zinc, carefully decant off the liquid and throw it away, then well wash the fine copper by pouring hot water on it, allowing the precipitate to subside, then decant off the water, and repeat the process two or three times, finally draining off all the water. To every ounce of copper precipitate, add now from 2 to 2½ ounces of mercury and a little sulphuric acid, to help on the process of combination. Stir the mixture well together, and form the paste into little pellets whilst soft, for they will set intensely hard in a few hours.

The Flux.—This is formed of one part metallic sodium, in from fifty to sixty parts of mercury put into a closely stoppered bottle, and kept carefully closed from the air. It is best to entrust the work of preparing this flux to a chemist. To use these ingredients: First prepare the surfaces of the metal joints by cleaning them as for ordinary soldering, then "tin" the parts with a small portion of the "flux." Next heat one of the solder pellets until the mercury oozes out on the surface in small beads, shake these off, pound the solder to a fine powder in a mortar until it is as smooth and soft as painters' white lead, apply it to the prepared surfaces, press the parts firmly together and leave them at rest for three hours. At the end of that time, if properly done, the joint can only be parted by a blow from a hammer, or hammer and chisel, or by sufficient heat to melt plumbers' solder. Any kind of metal may be united by this means, and it is especially useful in repairing fractures made in cast iron ornamental articles not subject to rough usage.

Cold Hard Solder.—Melt 10 dwts. of tin in a clay crucible, and add in the following order as soon as the tin fuses: bismuth, 1 dwt.; fine silver, 8 dwts.; platinum foil, 1 dwt. When well melted and mixed together, pour into a mould and make a small ingot. Reduce this to filings, and set aside until wanted.

To use this solder, prepare the article for soldering as before directed. Mix three parts of solder filings with one part of mercury in a mortar, and work it about until reduced to a smooth paste. Smear a thin coat of this paste on the surfaces to be united, and press them closely together. It will set hard in fifteen minutes, and cannot be made workable again by heat, so must be used as soon as prepared. If platinum is omitted from the composition, the strength of the solder is reduced, and its time of setting lengthened from fifteen minutes to one hour. This is a stronger solder than the preceding one, and is useful for joining fractured metal articles which cannot be exposed to heat.

Metal Inlaying.—Some beautiful effects can be produced in metal inlaying or in metal onlaying, by the use of these solders, or merely by the use of the sodium and mercury flux used with the soft solder first mentioned. This flux has the property of amalgamating itself with the surfaces of metals, and is therefore a very useful cement to fasten in small fragments of metal previously fitted into patterns. I may add here that the metal sodium readily forms an amalgam with mercury when shaken up with it in a bottle; but as it is not the best and safest stuff to be handled by an amateur, I advise the flux being made up by a chemist, who will understand the nature of the ingredients. There is no danger from handling it after it has been combined with mercury, but other considerations render it advisable not to freely handle and litter about any amalgam of mercury. The metal is apt to get under the nails and in other crevices, from whence it is transferred to coins and metal articles where it is not wanted, and thus cause trouble. It may be driven from copper and silver by the application of heat, and may be removed from gold by the action of nitric acid. The soft solder first mentioned, may be used in metal inlaying, and beautiful effects may be produced with filings and other fragments of various metals embedded in the surface of the plastic material itself before it sets, afterwards burnishing and polishing the same. In metal onlaying—that is, attaching various shapes of various metals to form a pattern or patterns on a metal bed or surface—the soft solder will be found invaluable as a cement, since it possesses an element of durability nearly approaching to ordinary soft solder, in a situation where this last could only be used with some difficulty. Many other uses will suggest themselves to amateur metal workers, but to all I would say, do not use it where common sense points out the necessity for welding, brazing, and soldering, in the ordinary manner.

Rust Joints.—Joints, fractures, and cracks in iron, are sometimes mended with a kind of cement which causes the iron to rust and amalgamate with the cement, thus making what is popularly termed a

"rust joint." The process is nearly akin to that of cold soldering, and may be done in either manner shown in the following directions: Grind 2 ozs. sal-ammoniac to a fine powder in a mortar, add 1 oz. flour of sulphur and mix the whole well together with 1 pound of cast-iron filings or borings. Keep the mixture dry until wanted. Then take one part of the mixture and add to 20 parts clean iron filings. Make this into a paste with water, and press it into the crack or joint. The mass will rust together and set hard. It is suitable as a packing for socketed pipes.

Another cement similar to the above, is made with 2 ozs. sal-ammoniac, 1 oz. flour of sulphur, and 5 lbs. of iron filings, and water. This is said to be useful in stopping leaks, and will set as hard as iron in a few days if left undisturbed.

The following was published in *Calvert's Mechanic's Almanack* for 1877:—"Take equal parts of sulphur and white lead, and a sixth part of borax; incorporate the three so as to form one homogeneous mass. When going to apply it, wet it with strong sulphuric acid, and place a thin layer of it between the two pieces of iron, which should then be pressed together." The author of this says he has used it with the greatest success in cementing iron railing tops, iron gratings, etc., and that in the course of five days it had set hard and dry, and appeared like welded iron.

Numerous similar recipes for iron cements might be added to these without any corresponding advantage.

Soldering and Inlaying by Electricity.—With a powerful electric current derived from a dynamo electric machine, a piece of metal wire may be made hot enough to melt common plumbers' solder, and in this way solder together small articles. It is also possible to unite pieces of copper together in an electrotyping solution by depositing a connecting band of copper around the closely-secured joints, and thus do a kind of cold soldering by electro-deposition. Beautiful inlaying effects may be produced by depositing metals from their solutions by the aid of electricity, in designs deeply etched in metal plates. The surface of the metal plate is first covered with varnish and allowed to dry. The design must then be deeply etched or engraved through the coat of varnish, the prepared plate hung in a solution of the metal to be deposited, and a current of electricity passed until the pattern has been filled up. The varnish is then to be cleaned off with spirits of wine, the deposited metal rubbed down with a burnisher, and polished.

A plate of steel can in this way be ornamented with a pattern made up of gold, silver, and copper, artistically arranged, and inlayed by electricity, or any one of these separately. When effects in all three metals are desired in one pattern, on one article, copper must be first deposited in all parts of the pattern. A mere surface deposit of the more precious metals will be required to give the effect, and this should be deposited on the copper. Stop off all parts desired to be shown in copper and silver, with varnish, and deposit gold from a cold solution first. Then stop off all the gilded parts of the pattern, clean off the varnish from the parts to be silvered, and deposit the necessary coat of silver. Finish by clearing off all the varnish and polishing the ornamented parts of the plate.

THE WOODBURY TISSUE.

By JOSEPH HARRIS.

II. — DESCRIPTION OF PROCESS OF MAKING THE "WOODBURY TISSUE"—VERGARA'S DARK SLIDE.

A FEW short months since, and the man who would have prophesied to the photographic world a continuous length of paper translucent as glass and flexible as silk, would have been regarded as an imbecile, or as one given to drawing upon his imagination at the expense of his veracity. And to-day this translucency, this flexibility of paper, is the basis of the business of the Woodbury Tissue Company.

A description of their works will be of interest to all who are votaries of the art of photography.

The first impression which the visitor will receive at the factory in South Norwood will be one of admiration at the completeness which characterizes every arrangement. Nothing is left to chance; every detail bears the impress of a mind which can study the minute as fully as it can grasp the complex whole, and in all things mindful of the precept of thoroughness which is essential to a perfect undertaking.

It is needless to observe that the process is a patent, and it may be well to refer to the specification for certain of the necessary details. A thin, even textured paper, not Japanese, is immersed in a solution of benzole or benzoline, in which has been dissolved a certain proportion of gum damar, mastic, or other gum of a like nature. To this is added a suitable proportion of an elastic gum, as elemi or india-rubber in solution, so as to impart the requisite flexibility to the transparent paper.

The proportion of the gums used may be varied, but the following formula can be used to advantage:—

Benzole	32 ozs.
Gum Damar	16 ozs.

Mix well for about twenty-four hours till the gum has been completely dissolved :—

Benzole	2 ozs.
Gum Elemi	½ oz.

Mix well for about twenty-four hours till the gum has been completely dissolved.

Mix the two solutions, and filter through fine muslin. Place the sheets of paper one by one into the solution, and let them remain for three days. Remove them singly, and dry in a chamber heated to 80 degrees Fahrenheit.

When thoroughly dry, the sheets can be immersed for a second or two in a solution of

Gelatine	2 ozs.
Water	40 ozs.

They are then ready for coating with emulsion, or for making tracings, drawings, etc., thereon.

At the Company's works the paper is prepared in specially-constructed receptacles, and there is no practical limit to the length in which it can be supplied. Machinery prepares it for the tanks, and machinery elevates it to an upper chamber for suspension and subsequent dessication. This upper chamber is a marvel of arrangement. An extensive series of frames run on iron rails fixed a short distance from the ceiling. Each frame holds a certain quantity of transparent paper, and each one as soon as filled, is passed down the ways away from the operator, who has another frame immediately to hand, to take the place of the one which has been filled; and this process is repeated without hindrance till something like two thousand lengths of paper are daily stored in the stock room.

The emulsion trough is fitted in a hot water tank near the ground, and the transparent paper in a continuous length is run through the sensitizing compound without break or stoppage, by means of an endless chain driven by machinery into a spacious drying chamber, arranged, fitted and ventilated by one of our most eminent engineers. The roof of this room is a perfect network of contrivances, each one most simple yet complete in itself for the purpose of suspending the sensitive tissue, and which, hanging in its now finished state, will measure its length in miles before being taken down when dry, to the adjoining packing room. Here it is stored in lengths to suit the roller slide, or cut to proportions for use with Vergara's patent dark slide.

Roller slides have their objections. Few people care to encumber themselves with a weighty and intricate mechanism carrying twenty-four exposures, when it is next to impossible to make twenty-four pictures in one day's work. And the Woodbury Company having foreseen this defect in the roller slide, have introduced the form known as Vergara's patent, which is undoubtedly destined to become *the* slide for all paper or tissue negatives.

Acting on this principle, the greater portion of this tissue is cut by means of a powerful machine, into the various standard measurements, and their gauges being mathematically exact, every paper may be relied on as absolutely correct to size.

It is an open secret that in addition to the possession of the finest tissue on the market, the Company are about to make good use of their position. They hold the necessary concessions for utilising their manufacture as a means of communication between producer and consumer in a manner which will revolutionize existing systems.

TRIFLING REPAIRS TO FLUTES, CLARIONETS, ETC.

By JOHN POCOCK.

PERHAPS musical and mechanical talents do not usually run together; at all events it is astonishing how many players upon those favourite instruments, the Flute and Clarionet, appear to be completely put out by even so simple a defect as an ill-fitting pad; for such a thing many an amateur will not only have to lose an evening of enjoyable music, but must next day send his ailing instrument off to a repairer, who of course promptly declares he can do nothing with it but repad it throughout, and charges accordingly. Then, again, very few amateurs are aware how easy it is to replace the string joints of their old instruments by the more modern and convenient cork joints. It is true some performers object to these latter on the ground that they are more liable to swell and crack the instrument, but I have never known this happen, whereas the string joints will often stick so hard that the keys may be seriously bent or even broken in the struggle of getting the joints apart; however, I am not now writing an apology for cork joints, which to all who have once used them will speak for themselves; so now for the more practical part of my discourse.

Pads are of skin, leather, or india-rubber. The first are the cheapest, but wear badly. The last I have heard very favourably spoken of, but have never used; the ordinary leather pads, however, are cheap and wear well, and of these I would therefore recommend the amateur to lay in a good store. The price should be about 9d. per dozen for the smaller sizes of pads, while the largest will cost 1s. per dozen; the best plan is to buy a couple of dozen of assorted sizes; or if the instrument requires repadding throughout,

the pads may be bought by the set, the prices being—for Clarionet, 1s. 4d., Flute, 1s., and Oboe, 2s. the set.

The pads are often put on with liquid glue, but I prefer to use shellac or sealing-wax, as the key is then ready for immediate use; moreover, as a piece of sealing-wax is usually to be obtained with ease in any house, the player need only carry a few spare pads in his case, and will thus at a moment's notice be able to set his instrument right, should he when away from home be troubled with a faulty pad. All that is necessary is to take off the ailing key—if the keys are on pillars the screw can generally be taken out with the point of a pen-knife; hold the key, pad upwards, a little distance above a gas flame turned rather low, until the old pad may be easily removed. Having taken it off, look out a new pad of the same size as the old one, and having again warmed the key, melt a very little sealing-wax into it, and press in the new pad. Sometimes when the key is a curved one, the pad will require a little humouring, and will have to be placed a little forward or backward on the key in order to close the hole properly. The key should therefore be placed in its true position over the hole, when any little adjustment that is needed will be at once perceived, and may be made while the key is still warm.

FIG. 1.—JOINT OF FLUTE WITH STRING BINDING REMOVED.

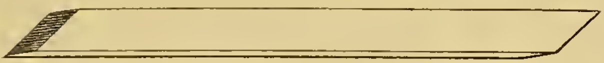


FIG. 2.—CORK JOINT FOR FLUTE SHOWING BEVELLED ENDS.

With certain keys in some instruments, as in the patent C sharp key and the upper ring keys attached to some clarionets, it will also be necessary to adjust the pads of the two keys acting together, so as to suit each other, for if one pad be too thick in proportion to the other, the latter will not properly close its hole. In this case, the key of which the pad stands out too much must be warmed and the pad pressed more closely into the key, or the pad of the key which does not close its hole may be taken off and a little more sealing-wax put into the key to raise the pad.

When pads show a tendency to become unduly hard I have found a little pure vaseline very good for softening them; and where an open key shows any signs of sticking, with the unpleasant result that the instrument does not speak promptly on the release of the key, a little fine powder, such as starch powder dusted over the pad, will be found to cure the defect in question.

Passing on to the subject of springs, these may be obtained at about 12s. per gross, or at the following prices per set:—Flute, 1s.; Clarionet, 1s. 4d.; Oboe, 4s. They are either screwed or riveted to the keys, and in neither case do they present any difficulty. They are finally adjusted to the touch of the player, by being slightly bent up or down with a pair of pliers, but if much alteration is needed in a spring, it is best to take it off, soften, bend, and re-temper it, bringing it down to a blue colour.

To put cork joints to a flute or other similar instrument, first take off any keys which project over the joint and cut off the string binding; the joint will then have the appearance represented in Fig. 1. Procure from the cork-cutter's a piece of thin sheet cork, and choosing a piece as free from holes as possible, rub it down with a piece of fine sand-paper stretched over a cork block until it is not much thicker than the depth of the recess into which it is to go. Measure round the joint with a piece of string, and allowing half an inch or so over, mark this measurement on the cork. Next measure off the width A, Fig. 1, with a pair of compasses, and guiding one leg of the compasses with a flat ruler, draw them along the cork, and cut with a sharp penknife along the two marks thus made, and to the length previously measured. Now bevel off the two short edges of the cork, as shown in Fig. 2, until the piece will just go round the joint, the edges neatly overlapping. The cork may be fastened on with liquid glue and bound up with tape until dry; but I usually employ a little pitch or bicycle cement, with a little wax added to it to render it less brittle. This mixture is more difficult to use than the liquid glue, but it has the advantage of wearing better, and that the joint can be at once finished off and the instrument ready for action. To use it, melt a little of the cement into the rebate in the joint, and holding the joint over a very small gas flame twist it round till the cement upon it is hot; now put on the cork as neatly and quickly as possible, beginning in the middle and pressing it round firmly; and see that the ends overlap with the bevelled edges together. Bind a piece of tape as tightly as possible round the joint and hold it for a few minutes to cool. A good deal depends on the right quantity of cement being used. If too much is put upon the joint, it will be pressed

out over the cork, and all the work must be done over again; if too little is used the cork will not stick properly. Should the cork not be firmly stuck at the overlapping end, this may be fastened down with a little cement inserted by means of a heated penknife.

Now carefully sand-paper down the joint all round until it fits easily but without shaking, into its socket, when the joint will be completed. Of course those who have a lathe can mount the joint upon a mandrel for this final process, which will then be better and more quickly effected.

All wood instruments should be carefully dried after having been used in playing before they are put away, by passing through them one of the small mops sold for the purpose; and if they are to be put aside for any length of time, say for several weeks, it is a good plan to pass an oiled rag (linseed oil is the best for this purpose) through them once or twice; they will then be less liable to crack; and we must remember the truth of which we are reminded by the Poet Laureate when he sings—

> "It is the little rift within the lute,
> That by-and-bye will make the music mute,
> And ever widening slowly silence all."

The outside of the instruments will also be the better for an occasional rubbing with the same oiled rag; but in this case the oil should be well rubbed off again with an old silk handkerchief, when a fine polish will be the result.

Clarionet mouth-pieces require re-laying from time to time, but this is an operation beyond the powers of an amateur, and the mouth-piece must therefore be sent to an efficient and trustworthy maker, preferably to the maker of the instrument in question.

Clarionet reeds are also troublesome. Good ones should always be purchased, but even if sixpence each be paid for them, it is too probable that only a small proportion of them will be found serviceable. A good reed then is a thing to be carefully treasured when found. Such reeds as are too stiff and hard to suit the player, may, however, be softened by carefully scraping them at the base.

Broken keys may be brazed, but if the key is of German silver, a new one will cost so little that the broken one will scarcely be worth repairing.

I have found vaseline most useful for lubricating the joints; an occasional dressing with it will entirely prevent them from sticking.

Perhaps the foregoing remarks may prove useful to some reader who plays the instruments I have mentioned, by enabling him to cure some of their slighter occasional ailments, and thus to overcome the obstacles which are apt to stand in the way of our enjoying an hour of music in the leisure intervals of a busy life.

HOW IT WAS MANAGED.

A SERIES OF PRACTICAL HINTS, SUGGESTIONS, AND WRINKLES.

FROM AMATEURS FOR AMATEURS.

XXVI.—CIRCULAR SAW TABLE AND DRILL ATTACHMENT FOR LATHE.

[*From* G. T. HARDMAN.]

I SEND herewith a couple of hints for amateurs that may be wanting a Circular Saw Table and Drill Attachment for Lathe. I venture to think that the diagrams will speak plainly enough for themselves, and that I need do nothing more than name the different parts in each, indicated by letters, and touch briefly on the purposes they are intended to serve. I made my saw table for a 5½ inch centre lathe. I have not drawn the diagrams to scale, as this will of course vary for lathes of greater or less size than mine. With regard to the Circular Saw Table, Fig. 1 shows the side view, Fig. 2 the end view, and Fig. 3 the plan or view as seen from above.

In Fig. 1 A is the saw, B movable saw fence fixed by two bolts and thumbscrews, G, in Fig. 3, moving in slots in two pieces, K, Fig. 3; C screw to raise table top for rebating or grooving; D, hinges for table top; E, lathe rest screw; F, saw spindle.

In Fig. 2 A is the saw; B, saw fence in two pieces equal size, hinged at the top as M, in Fig. 3; D, hinges for table top; E, lathe rest screw; F, saw spindle; G, bolt and thumbscrew for regulating saw fence; H, wooden screw passing through back part of saw fence, by turning which the front of saw fence can be slanted as at the dotted lines I, so as to cut bevelled edges for piecing fret-work, etc.; K, the slotted pieces in which the grinding bolts, G, work; L, the table top.

In Fig. 3, A is the saw; B, saw fence; G, guide bolts; H, bevelling screw; I, movable front of saw fence; K, guide slots; L, table top; M, hinges fastening the two parts of the saw fence together at top side.

With reference to the drill attachment for lathe, I have a three-jaw chuck, but the jaws prevent me using any but long drills. I therefore hit on the following plan: Having one of Melhuish's hand drills, price 5s., as shown in Fig. 4, I knocked out the pin at A, and thus had a chuck piece shaped as shown in Fig. 5, which I found fitted nicely into the three-jaw chuck, and did its work nicely too. In this A is the three-jaw chuck; B, bevelled wheel; C, chuck to receive drill, and D, drill.

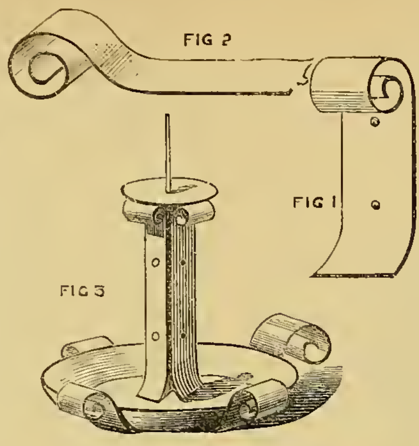
XXVII.—A SIMPLE CANDLESTICK.

[*From* D. B. ADAMSON.]

"Hold their glimmering tapers."—CRABBE.

GAS not being a household commodity in the village where I have been living during the winter months, the "shining lights" which become necessary indoors "soon as the evening shades prevail," are principally derived from

candles or paraffin lamps. The latter I don't like—they sometimes smell, and I decided to use a candle for my own private den in which I read and write. The illumination is certainly not excessive in brilliancy, but it is enough for one of moderate desires, and then just think how very convenient to be able to light one's pipe without even the trouble of striking a match. There is no temptation for even the laziest man to lay his pipe down when it has gone out almost at the first whiff with the flame standing close handy. A bottle makes a convenient candle-stick, but as it is not considered proper in well-regulated households, nor I must confess is it ornamental, I humoured the powers that be and my own tastes in using something else. What that something else is, and how it was made I proceed to tell, thinking it may perhaps be interesting to some. The materials are very simple and inexpensive. The result useful and artistic, as it stands before me. Cut strips of tin, or tinned iron, about $\frac{3}{4}$ inch wide, eight of them being required—pieces from an old biscuit tin will do very well. Four of them are shaped, as shown in Fig. 1. Their length may be 3 to 5 inches, and they form the stalk, or rather the covering of the stick, which is a piece of wood squared up, so that each side is the same width as the tin, which must be fastened to it by pins or small screws where indicated. Cut the top and bottom of the wood level with the metal. On the top by means of other screws fix a round plate of tin about $1\frac{1}{2}$ or 2 inches in diameter, to catch any gutterings from the candle. In the centre of this plate, and running through into the wood put a piece of wire sharpened at the upper end to serve as a spike on which to fix the candle. The tray of the candlestick is made of an ordinary tin plate pan measuring about 3 inches across. Under it are the other four strips of tin, which are bent as in Fig. 2, at each end. These are placed underneath the pan at right angles to each other and a nail driven through them into the wood. The candlestick is then complete, but is much improved by painting the stalk and feet a dark green and the tray a dull red. The circular piece of metal is left bright for convenience of cleaning. I have omitted to say that an end of one of the bottom strips is bent into a larger curl to serve as a handle. No doubt heavier metal than such as I have described would be better, but I dare say those who have the requisite appliances will without difficulty improve on the hints I have given. I think that if any one makes a candlestick on my pattern, and with the materials suggested, he will be satisfied with it when finished.



A SIMPLE CANDLESTICK.

Fig. 1. — Pattern of Supports for Candle. Fig. 2.—Pattern of Supports for Pan and of Handle. Fig. 3.—Candlestick, complete.

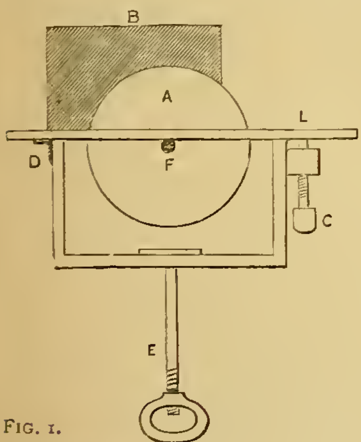


Fig. 1.

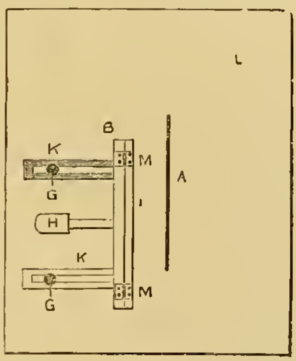


Fig. 3.

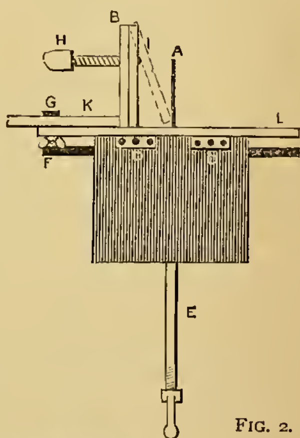


Fig. 2.

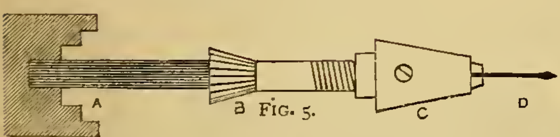


Fig. 5.

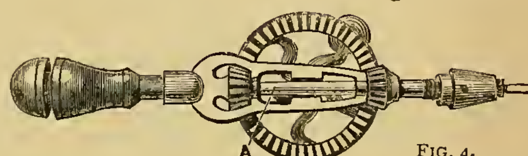


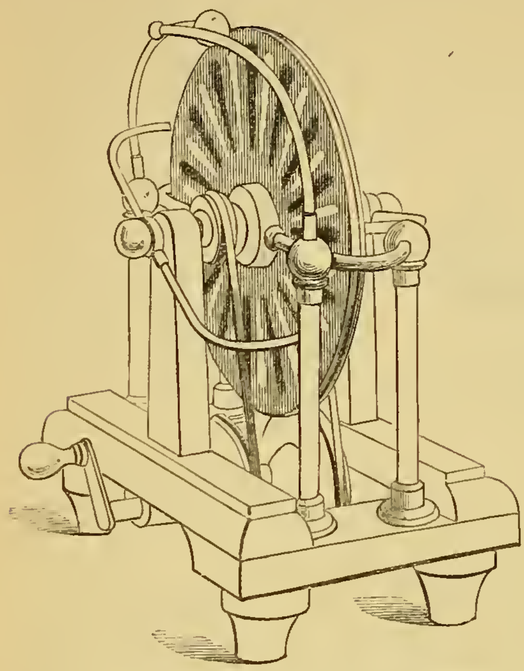
Fig. 4.

Circular Saw Table and Drill Attachment for Lathe.—Fig. 1.—Side View of Saw Table. Fig. 2.—End View. Fig. 3.—Plan or View as seen from above. Fig. 4.—Melhuish's Hand Drill, No. 1. Fig. 5.—Drill Attachment—A, Jaw Chuck; B, Bevelled Wheel; C, Chuck; D, Drill.

XXVIII.—CUTTING PLATES, ETC., FOR WIMSHURST INDUCTION ELECTRIC MACHINE.

[*From F. R.*]

WITH reference to the recent article in AMATEUR WORK, on the "Wimshurst Induction Electric Machine,"



WIMSHURST INDUCTION ELECTRIC MACHINE, MADE BY F. R.

I send you two photos.* of one I made last winter, and recently sold through your columns; and for the benefit of fellow-amateurs I should like to offer a remark or two. First, the glass discs will doubtless give many amateurs trouble, especially cracking the hole through. I spoilt three plates before I cracked one through successfully. The plates should be cut on a revolving table—most respectable glass warehouses possess a machine for cutting discs—and without shifting the plate the inner circle should be scribed, the size of the hole required. Within this circle the glass should now be scratched, or rather cut all ways with a diamond, being very careful not to go over the circumference of the circle. Now comes tapping the hole through, and the following wrinkle was given me by the man who cut me the plates: "Place a sharp steel point in the vice; when I say sharp, I mean sharp at the extremity, but at the same time strong enough to be destitute of all spring. A small centre punch is as good as anything if ground off rather sharper than the average. Take another steel point in the right hand, this point should have something affixed to it to make it weigh about a quarter of a pound according to the thickness of the glass. Place the plate over the first point, in the vice, exactly in the centre, and then begin to tap with the other point, keeping the top one fair over the other. Use short quick strokes, and the glass will begin to powder at the point where it is tapped, at the same time causing the cuts to run to the circumference of the circle scribed, and possibly round it. When the small hole is nearly through, the plate may be turned over and started from the other side, so as to meet in the centre. The rest is comparatively easy, as it simply consists of tapping a bit of the edge away until the circle is reached, using slower, sharper, and firmer strokes. It will often be found that the piece will drop out in the form of a ring.

The reason I consider this superior to the way described by Mr. O. Beckerlegge is, because few amateurs would be able to file a piece of tube flat enough for the purpose, and if it was not perfectly flat it would crack the glass. The pulleys shown on the machine are much better if made with a V-groove, and amateurs will find that the machine is very much harder to turn when thoroughly excited than before it is working properly.

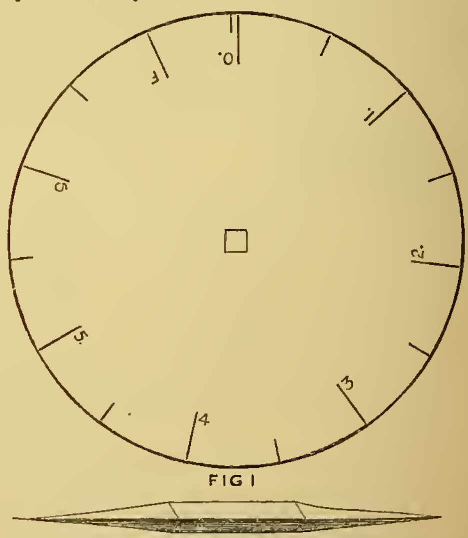
* One of these photos., affording a excellent general view of the machine, is engraved and given above.—ED.

XXIX.—A HOME-MADE CARTOMETER.

[*From LEWELLYN LEWIS, Leipzig.*]

HAVING long wished to have an instrument to measure distances on maps, and the "Cartometers" sold here, in Leipzig, being too dear for my pocket, I set to work to think out a substitute for these.

The dial, which was the result of my work, you will find illustrated in the annexed diagram in Fig. 1. I think it may be useful to bicyclists, tourists, etc., who are in the same position as myself.



HOME-MADE CARTOMETER.

Fig. 1.—Cardboard Disc. Fig. 2.—Wood forming Axis of Disc.

For its use, all that is required is to place the edge of that part of the dial at which the 0 line ends on the spot from which one wants to start and roll the dial over the map in the direction wished to be taken. The number whose line is on the place of destination gives the number of inches contained in the distance covered on the *map*. This number is to be multiplied with the second figure of

the proportion which gives the scale on which the map is drawn.

The result of this multiplication is in inches, and has, of course, to be reduced to yards and miles. Thus, supposing the distance to be measured is 5 inches on the map, and this is drawn on the scale of 1 : 260000, the real distance between the two places will be found in the following manner:—

5 inches × 260000 = 1300000 inches.

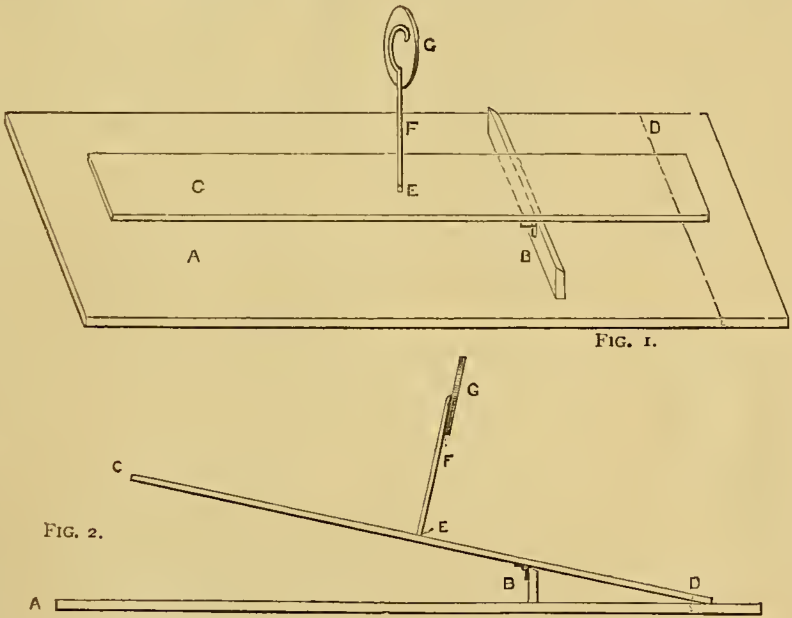
1300000 inches ÷ 36 = 36111 yards.

36111 yards ÷ 1760 = 20 miles 911 yards.

The distance is therefore 20 miles 911 yards.

The cost would naturally be almost nothing, and the whole thing can be made in less than a quarter of an hour.

It does not in the least matter of what size the dial is as long as the inches are correctly marked on the edge. The dial, in fact, is nothing more than a disc of cardboard with the edge graduated in inches starting from the line marked 0, shown in Fig. 1. The piece of wood, Fig. 2, is to be put in the hole in the dial and to be held between the fingers while rolling the dial over the map.



A SIMPLE HELIOGRAPH.

Fig. 1.—Plan in Perspective. Fig. 2.—Side View or Side Elevation.

XXX.—A SIMPLE HELIOGRAPH.

[*From P., Natal.*]

As amateurs in the colonies have to make wonderful shifts, in doing which they find AMATEUR WORK an invaluable help, I am induced to send you an account of a contrivance which W. S. M. (p. 96, Vol. V.), and others who have made inquiries about Heliographs, will find to be both simple and efficient. I have tried it, and the instrument described by "CASENHEM" (Vol. V. p. 287), and found them to work well, both for short and long distances, say to thirty miles, perhaps not as well as the instruments manufactured for the use of our army: but I have never seen one of them, so cannot judge; but with this instrument, which any amateur can make at a cost of sixpence, and a little practice in using it, anyone who has need of this mode of communication can do all the speaking, or rather, telegraphing, that he is likely to want.

A is an inch plank, say 18 in. long by 6 in. wide for steadiness; B is a fulcrum 3 in. by 1 in. by $\frac{3}{4}$ in., chamfered at the top for C to work on; it is screwed on to A from underneath, say 5 in. from one end; C is a plain piece of wood 15 in. by $1\frac{1}{2}$ in. by $\frac{3}{4}$ in., hinged (without play) on to B, 5 in. from one end. The dotted line D is an ordinary stout india-rubber band (or it may be a steel spring), its use being to keep that end of C always down on A when not in use. At E, say 3 in. from fulcrum, bore a hole for the insertion of a wire F, which has to carry the glass. Let the glass be a common round zinc mirror three or four in. in diameter, costing 2d. to 4d. At the back, in the centre, make a hole (with the point of a knife or small tool) through the zinc, paper, and whatever there may be, leaving the glass clear (less than an $\frac{1}{8}$ in. large); then solder to the back a piece of stout wire F ($\frac{1}{8}$) pointing to the end, so that it will enter the hole E and support firmly the glass G, leaving some 3 in. between the glass and plank C. The instrument is now finished, and only requires practice when the sun is shining to be able to speak with it as fast as any telegraph clerk can who uses the Morse code. A thick wedge or two to raise the stand A at one end or the other, according as the sun is high or low, will be found useful, and a lump of stone, iron, or other heavy substance, placed on the corners of A, will help to steady it. The glass can be twisted round by hand, as it is found the sun is travelling. Should the sun be behind the operator, a second glass must be fixed, to throw its rays on to this glass.

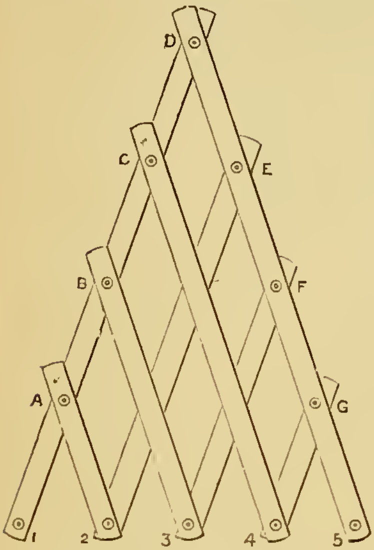
For a short distance like three miles, to ascertain that your flash is directly on your object, all that is required is a forked stick, stuck in the ground (dark, or with its bark on, is best), or a piece of plank cut shape at the top, placed three or four feet or more, from the glass. Look at your object through the little hole at the back of the glass, and see that the fork of the stick is in a direct line and level, and you need not again look at your object, but only observe that your flash each time strikes that particular part of the fork that you observed. For long distances you want two forked sticks, and with a telescope see that both forks are in line with your object. Then your instrument must

be raised o lowered, so that your flash strikes both forks. Be careful rot to let your flash travel above the spot on the stick tbat you have observed, or you will show two flashes: one while travelling upwards, and another as it comes down.

XXXI.—A PANTOGRAPH EXTRAORDINARY.

[*From W. BLACHFORD HILL, Chettle Rectory, Blandford.*]

THREE different sized copies of a drawing can be made at the same time by the help of a Pantograph constructed according to the plan shown in the accompanying illustration.



PANTOGRAPH EXTRAORDINARY.

I need not give any dimensions, but care must be taken to place all the strips sloping one way uppermost, and all those sloping the other way undermost, and the hinges at A, B, C, and E, F, G, at equal distances, so that the bars D 1 and D 5 are divided into four equal parts.

In working the Pantograph, if the pivot is fixed at 1, and the tracer at 5, and the pencils at 2, 3, and 4, the copies produced will be one-quarter, one half, and three-quarters the original; and if the tracer is fixed at 2, and the pencils at 3, 4, and 5, the copies will be double, three times, and four times the original drawing, and other variations can be made in similar proportions.

NOTES ON NOVELTIES.

By THE EDITOR.

63. WOOLFF & SON'S FRAME-CLOSING DRAWING BOARD.

63. WOOLFF & SON'S FRAME-CLOSING DRAWING BOARD.—The demand upon my space this month for the insertion of the Indexes to the present volume, and the necessity of giving as many replies as possible to expectant correspondents in "Amateurs in Council," prevent me from noticing more than one novelty this month in Messrs. E. Woolff and Son's "Frame-Closing Drawing Board," which may be obtained from most fancy stationers and dealers in artists' materials. It is rightly claimed by Messrs. Woolff and Son, the sole manufacturers, that the board is at once "effective, simple, and compact." This may be seen from Figs. 1 and 2, in which the construction of the board is clearly shown. From Fig. 2, it will be noticed that the board consists of a central piece, to which a framing is attached by slips of brass, screwed at one end to the board, and at the other to the framing, so that the pieces of framing may be pushed close to or away from the edges of the board, after the manner of the two

FIG. 1.—THE FRAME-CLOSING DRAWING BOARD, CLOSED.

slips of which the ordinary parallel ruler is formed. The board is grooved at the edges, and the inner edge of each piece of framing is wedge-shaped, so as to fit into the groove to which it is opposite. The paper should be cut to the size of the board, including frame when closed. It must then be damped in the usual way and placed evenly on the board with the frame open. The margin projecting over the edges of the board must then be creased sharply over them, and it is recommended that this should be done with a piece of

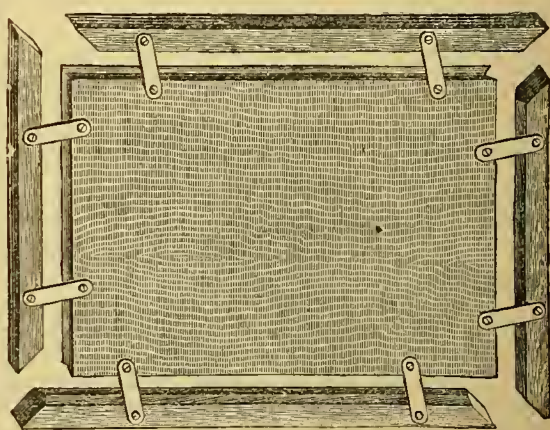


FIG. 2.—THE BOARD OPEN, SHOWING BACK OF BOARD.

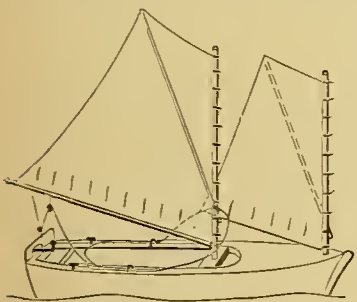
clean paper. The framing must then be closed on the paper and the angles pressed well together and fastened with the catches tbat are shown at each corner in Fig. 1. The corners of the paper need not be cut off. When the catches are fastened, the paper must be allowed to dry in the usual manner, and when dry will be found to be well stretched and perfectly even. These boards are made in two sizes, quarto-Imperial, sold at 5s., and half-Imperial, at 7s. 6d.

AMATEURS IN COUNCIL.

*** *For Instructions to Correspondents, see page 44 of this Volume.*

Rig for Small Boats.

SCHOOLBOY writes:—"I would like to call the attention of your readers to a rig which is very much used in Finland for small boats. The same rig is also used in England, but I think the Finnish manner of hoisting the sails decidedly superior. The foremast is stepped about a foot from the bow, and is slightly smaller than the mainmast. The sails are attached to the masts by large rings of cane or willow, and the sails are hoisted by only pushing on the spreet. This is, I think, a great improvement to hauling up the luff of the sail by a rope, and then sticking out the peak with the spreet. The boom must be very long (in the sketch I have shown it too short) or else the boat will not go close to the wind. If the mainsail is very broad at the top, a



FINNISH RIG FOR SMALL BOATS.

jib is necessary, but it is better to have it narrow with a long boom. It is best to have one spreet on one side, and the second on the other, as then the boat goes equally well on both tacks. These boats are very safe, and if they have half a deck, as shown in the sketch, which is not drawn to any scale whatsoever, nobody need be afraid to go out in them, however strong the wind is." [With reference to the subject named in your letter that accompanied the above, all proposals to write papers for the magazine should be accompanied with name and address. Write again, giving a syllabus of what you propose to write on Fitting and Metal Working, and I shall then be better able to judge whether or not your papers will be suitable for the magazine.—ED.]

Inserting Gusset in Front of Boot.

TOM PATTON.—As your appeal for help in this matter has been sent to me, I will try to give it as clearly as possible; but I must first say that you have undertaken a job which would put many a cobbler in a fog. First of all, you must cut a hole as low as a lace boot is open, that is to where the vamp would meet it, and carry it on as high as is needed to give the ease required. Next take a sharp knife and skive the face of the upper for about half an inch from the edge, pretty thin, get a piece of good calf, not too stout, at any leatherseller's, a little longer than the opening and 4 inches wide, cut this into four strips and lay one each side of the hole, leaving it to project below the opening one-eighth or more. If he have paste at hand stick it, if not put a stitch each end to keep it in its place, then take the tongue or gusset—for which a piece of soft thin calf offal will do very well —cut it the proper size, which you can soon find by measuring, but mind it has to be put flush with the edge of the other piece and laid flat with the upper on the inside to the depth of your piece, and then turned back, keeping the black face outside, and fixed on the other side in the same way. If you can look at a waterproof boot you will see clearly what I mean. You can also see what depth the outside pieces are left if you don't like them quite the inch. Then with a fine thread and closing awl stitch it neatly through and through all round. The pieces may be joined at the top, it will make it look better. As regards getting the inside thread out when stitching in the inside of a boot, the hair of the inside thread is held between the thumb and forefinger of the left hand, with the point just flush with the top of the finger; the awl is put through from the outside, with the right hand you must feel for the point of the awl and guide your hair to it, and push it into the hole as you pull the awl out—this is the proper way to blind stab. But there is another way, which is called leading; after making the hole put the outside hair in first, draw it three parts through, make a hole in it, and put the inside hair about half its length through it and then pull it back by the loop left on the outside until the inside hair comes out. All sorts of leather is used for patching—a good workman will match what he has to mend. The terms used here denote the character of the boots. 1. All kip, are such as strong navvies' boot tops. 2. Levant seal is a black, wrinkled, shining leather, used for ladies' boots. 3. Wings is short for wing vamps. 4. Lace-pieces, unless this means imitation lace, I can't make out what it is. 5. Calf is what is used for gentlemen's boots. 6. French calf is just the same thing but a little superior in finish. 7. Kid is a soft, velvet-like leather, used for ladies' boots and gloves. There is more than one sort — the plain black, glace, glove, and white. There is a wheel tool called a rivet marker, for marking the distance at which to put rivets, which can be bought at the grinder's, the price is about a shilling. I am very glad to find you can get on so well, and hope these hints will put you all right.—A. M., *St. Helen's, Jersey.*

Exactness in Quantities.

SCIENTIA writes:—"I have had occasion to do a little French polishing, and have made use of the very valuable articles in Nos. 25, *et seq.*, of your valuable magazine. But may I venture to suggest, with the greatest deference to the superior skill and experience of the writer of those articles, that measurements, or quantities should always be given *definitely*. A *pennyworth* of Vandyke brown will vary considerably, I imagine, according as it is bought in a large or small town. In the far greater number of quantities given in these articles the quantities *are* given exactly, so my grumble must be simply taken as a suggestion that they should *always* be so." [You are right in desiring that writers should always be exact in stating quantities when giving recipes, etc.; but, I dare say, there would not be sufficient variation in the quantity of Vandyke brown bought anywhere, and of any oil and colourman for 1d., to imperil the utility of the recipe and the success of the process. A little colour, more or less, could only cause a slight variation in the depth of the tint when the process was finished.—ED.]

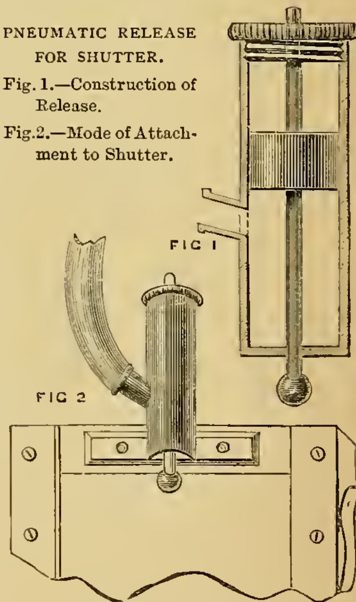
Pneumatic Release for Shutter.

LEX.—The accompanying cuts illustrate a pneumatic release, which may be used with the "drop and flap" shutter described in the August Part of this magazine. The limits of our "Council" columns prevent a description of the release, but you will understand how it is made, and the prin-

PNEUMATIC RELEASE FOR SHUTTER.

Fig. 1.—Construction of Release.

Fig. 2.—Mode of Attachment to Shutter.



ciple on which it works from Fig. 1, while Fig. 2 shows the mode of attaching it to the shutter. I am afraid you will find the making of this no easy matter, and the easiest and cheapest way would be to procure one ready made from Mr. A. A. Pearson, 46, *Queen's Place, Leeds*, who supplies them for 6s. 6d. or 7s. 6d. each.—C. C. V.

Title and Index to Vol. I. of "Amateur Work."

A. W. H. (*King's Lynn*).—The Title page and Index to Vol. I. of AMATEUR WORK, comprising Parts 1 to 11, inclusive, was issued with Part 12, and Title page and Index to Vol. II., comprising Parts 12 to 23, inclusive, with Part 24. Since that time title pages and indexes to volumes have been issued with the last part of each volume. All back parts are on sale. If you do not find what you require in Part 12, write to the publishers and they will supply the omission.

Revolving Back for Camera.

LEX.—A revolving back is not to be compared with the more simple reversing back for practical work, and requires too much space for portability. You should have no difficulty in copying Newton's Revolving Back, or, better still, let them make one to fit your camera.—C. C. V.

Model Engine Making.

F. A. M. writes :—"I notice the following misprints in Mr. Pocock's article on "Model Engine Making." In page 447, column 1, line 21 from bottom, 'latter' should be 'former;' and in column 2, line 25, 'bed-plate' should be 'face-plate;' and in line 31 'place' should be 'fin.' In page 450, line 8, 'boring-bar' should be 'boring-bit.'"

Carved Overmantel.

H. H. (*Canterbury*) writes :—"I feel very desirous of trying my prentice hand on the making of an overmantel, with shelves for flowers, vases, etc., and introducing panels carved in low relief, according to Mr. Edwards' 'Lessons in Wood Carving,' all of which I have dutifully completed, and, like Oliver Twist, 'ask for more.' I have in hand a very beautiful design for an overmantel, by Mr. Adamson, and it is possible that some panels in low relief may be managed in this, and if so, designs shall be given. At all events you may rest assured that your wish shall receive attention."

Bogus Advertisements.

C. H. (*Oxford*) writes :—"I beg to apologise for writing this, but I would like to draw your attention to a 'bogus' advertisement which appeared in the July Part of your valuable magazine. The advertisement related to a copper boiler, which was said to be riveted, and, amongst other fittings, to posses a steam gauge. The money was sent in advance (as I understand it usually is in such cases); but when the boiler arrived it was not riveted, but soldered, and possessed no steam gauge. For this useless piece of trash, which leaked when under steam, I had to pay the fellow (whose name is ——— ———, and whose address is ———) the sum of 15s. and 1s. 11d. carriage. Cannot you reform the present system of barter as practised in your columns? At least, I think you would do well not to insert any advertisement which ——— ——— may send in future, and also to publish the name of any advertiser who may impose on the readers of AMATEUR WORK."
—[I am sincerely sorry that you should have been the victim of misplaced confidence in this case—the boiler being in the condition in which you represent it to be. Advertisements in the Sale, Purchase, and Exchange Department of this Magazine are paid for, and it is impossible for me, as I do not see the articles advertised, to say if they are in strict accordance with everything that is said of them. I undertake to do nothing beyond forwarding answers to their respective destinations. This done, buyers and sellers, and exchangers must look out for themselves, and—*caveat emtor!* I am inclined to think it was rash of you to part with 15s. before seeing the boiler. I never buy "a pig in a poke" myself, but always satisfy myself to the best of my power that I am getting value for my money. I cannot publish the "*fellow's*" name and address, for fear of an action for libel, which the publishers would not like. Again, the fellow might say that it was all a mistake on your part, which would be awkward and lead to complications. If things are as you state them to be, the fellow simply swindled you, for which I am sorry; but I think more blame attaches to yourself for buying on spec., than to the system on which the Sale and Exchange Department is managed.—ED.]

Measurement of Electric Currents.

W. G. B.—The Current Detector described and illustrated in Vol. I. may be used as a part of the measuring apparatus employed in roughly estimating the strength of an electric current, but you cannot by its use alone determine "to a certainty its exact strength in numbers." The electro motive force of current—that is, its power to pass through resistances, may be roughly estimated in volts by experiment with the current detector and cells of Daniell's battery. An ordinary pint Daniell cell will give an E. M. F. of 1·8 volts. Couple such a cell to the instrument and note the deflection of the needle; put that down as representing one volt, then couple two such cells, again note the deflection, and put that down as representing two volts. So go on, actually adding cells until the needle refuses to register any higher deflection. You will thus obtain a rough idea of the value of its deflections and can compare the register with that taken from the effects produced by the current from any other battery. A detailed account of how to arrive at exact estimates with proper instruments cannot be given here. You will find the subject fully treated in Mr. Sprague's new book on Electricity, published by Spon and Co., *Charing Cross*, at 15s. Messrs. Ayrton and Perry's Anemometers are constructed to show by figures on a dial the strength of an electric current passing through the instruments, but these are very costly.—G. E.

Map Colouring, Mounting, Etc.

Mr. JOHN BRION writes: — "Your engraver, while doing his work very well, has unfortunately made two omissions in the Outline Map of Palestine (page 461). The figure 3 ought to have been inserted between F and G, north; and the figure 8, eastward of E. These, as explained in my text (page 460, column 2 near the bottom), are portions of the tribes of Dan and Manasseh. I fear it will perplex a tyro, but it cannot be remedied now, otherwise than by pointing out the errors."

G. M. H. (*Blackheath*).—Mr. JOHN BRION has already given in his papers on this subject, "full particulars" as to map colouring, and if you cannot understand how to manage the work from what Mr. BRION has said, you must endeavour to find some one who will *show* you how to do it. I cannot enter on "*map-drawing*" in this magazine.

Steel-centred Fishing Rod.

E. C. F. (*Halifax*).—The steel centred fishing rod mentioned in Vol. III., p. 339 of this Magazine, is supplied by Mr. D. W. Foster, *Ashbourne, Derby*, and Messrs. Hardy Brothers, *Alnwick, Northumberland*, but cost of carriage, etc., might be saved as well as delay, by applying to any fishing-tackle maker in New York. These rods, I believe, are looked upon with more favour on your side of the Atlantic than on ours.

House Painting.

A WANDERER.—Strip off every scrap of paper from the walls; stop all cracks, crevices and flaws with plaster; rub all the surfaces down smooth with a cork scrubber, and thus prepare them for painting. Full instructions are given in my series of articles on "House Painting and Papering," published in Vols. II. and III. of AMATEUR WORK, Illustrated. The whole series should be read if you wish to understand how to do the work properly, since the first chapters give details of preparing, and the remainder treat of the colours to be employed and how to lay them on.—G.E.

Scene Painting.

PAHEKA (*New Zealand*).—Concerning the painting of the subject, Fig. 55, pages 120, 121, Vol. V., you say your rose pink for road looks too red; if put on pure, no doubt it is so. Did you add whiting? Throw some shadows over road and put in ruts with sienna, add a little blue to your rose pink and make a grey for shadows. Should you like a coloured design on cloth (3s. 6d.) of this subject? In answer to other queries—(1) Yes, foliage is first laid in with the blue, and the other remarks refer to second painting. You are mixing up the laying in with second painting. (2) Lemon chrome and all three colours are used separately. (3) A little green may be used in foliage for mid-distance, but a grey or blue is best for extreme distance. (4) Dutch pink is a yellow, so footpath cannot be too red. You mean rose pink. (5) The water was laid in with blue, but may possibly have been hidden by successive paintings. In speaking of vandyke glazing and sky blue, I refer to the finishing touches. (6) Samples of colours submitted are the common Brunswick greens—1, pale; 2, mid; and 3, deep. They are used for foliage, grass, etc.; other greens can be made from them. (7) Snow scene shall be sent to you in due course. (8) Your designs would be acceptable for purpose mentioned.—H. L. B.

Saw Setting and Sharpening.

IGNORAMUS.—I have a paper in hand on Setting and Sharpening Saws, which will be published as soon as I can find room for it, and which, I think, you will find helpful to you. Saw-sharpening, however, is a delicate operation to be performed, without a little practical insight into the way of going to work, and, as you say that a saw you have attempted to sharpen will not go through a piece of wood of ordinary thickness, it seems to me better for you to lay out a shilling in getting a little explanation on the subject from a carpenter, or an itinerant saw setter. In an operation of this sort you will learn more by watching other people at work than you will from written or printed instructions, however clear and to the purpose they may be.

Balmain's Luminous Paint.

C. S.—This answers perfectly well in use, provided that it is in a position to absorb the rays of the sun during the day. A preparation called "Neutral Base" is first applied to the article, to be coated with the Luminous Paint, and this is spread over the base when dry. The base and paint may be obtained from Perry & Co., *Holborn Viaduct.*

Screwdrivers.

F. A. M. writes:—"I was interested in the remarks of Goldsmith in page 478, on the question of Long *v.* Short Screwdrivers. All workmen believe that more power is obtained with the long one, and, as this is the result of their practical experience, I take it they are right. When, however, they go on to explain that it is because there is 'more leverage,' they are evidently arguing from the action of a crowbar. The question of leverage comes in just as it does in the wheel and axle. The 1 lb. on the wheel will balance 10 lbs. on the axle, if the wheel be ten times the diameter of the axle. In the screwdriver the body of screw is the axle and the handle is the wheel. If the screw be $\frac{1}{10}$ in. diameter, and the handle 1 in., then the leverage is as 10 to 1, and the length of the instrument does not affect the question of leverage at all. But there is another matter which it does affect. We all know that in driving a screw we have to exert force, not only to turn the handle, but also to press it forwards so as to prevent the point of the driver from escaping out of the notch. Now, when the shaft of the screwdriver is long it will, generally, cause the elbow to be bent, so that the arm becomes something like the leg of a grasshopper, and the hand and wrist come close to the side. In this position much greater force can be exerted than with the hands 12 inches in front of the chest. Greater force to turn the handle and greater force to keep the chisel end from jumping out of the notch. The length of the screwdriver enables greater power to be exerted, because it places the muscles of the arm in a more favourable position."

Reseating Chairs—Wood *v.* Cane.

R. A. W. (*Dublin*) writes:—"I see some of 'Ours' wish to reseat their chairs, and think of doing so with cane. To these I would offer Mr. Punch's advice on another subject—Don't! It is much easier to put on the wood seats made for the purpose, and the chairs will gain in appearance and strength. They are cheap, being sold by most hardware houses at from 6*d.* for the smallest size upwards, both circular and square. For 14 inch squares, an ordinary bedroom chair size, I paid 9*d.* To put on new seats, take off the old cane, cut a piece of paper the shape of the bottom of the chair, mark and cut out the seats from this pattern, smooth the edges with spokeshave and glass paper, and nail them on with brass-headed nails, such as are used by upholsterers. The new seats need not follow the outline of the original cane seats, but rather that of the bottom of the chair itself, in any case, care should be taken that they are large enough for the nails to escape the old holes. If the chairs are shabby, they will be improved by a coat of black varnish, put on before the seats are nailed on. The circular seats are, of course, intended for chairs with circular bottoms."

Japanese Vases for Shaving Frame.

Shri Krishna.—The Japanese vases mentioned by Mr. Gleeson-White are merely small saucers about 2 inches or $2\frac{1}{2}$ inches in diameter. They are often to be bought in the streets in London for 1d. each, and may be obtained, I imagine, of dealers of fancy goods, such as Mr. George Rooke, *Newgate Street, London, E.C.* They are sent out with the "Gold Paint" manufactured by Messrs. Daniel Judson & Son, *Southwark, London*, and Mr. Walter T. Craig, *Miller Street, Wick, N.B.*, who, I am sure, would let you have a couple if you write to him and mention the name of this magazine. For varnish for fretwork apply to Messrs. Harger Bros., *Settle, Yorkshire*, Messrs. Skinner & Co., *East Dereham, Norfolk*, or any dealer in articles required by fret sawyers. You can also apply to any of the advertisers of varnishes in our advertising pages.

Specification for Organ.

Flashing Dynamo.—I should think an organ of about 3 or 4 stops would suit you, the specification of which might be as follows:

Dulciana	44 pipes...8 ft. tone	
Stopt Diapason	56 ,, ...8 ft. tone	
Flute	56 ,, ...4 ft. tone	

to which might be added

Vox Angelica	44 pipes...8 ft. tone, or
Flageolet	56 ,, ...2 ft. tone

This specification, *with the pipes lightly voiced*, would give you a sweet-toned instrument not too powerful for your room; and if you add a swell box to enclose all the pipes you will have an additional advantage.

Size of soundboard, 4 ft. 6 in. by 1 ft. 4 in.
or, if this is too long
4 ft. by 1 ft. 7 in. } 4 stops.

Full information as to construction and scales of pipes will be found in Vols. 2 and 3 of this magazine.—M. W.

Failures: their Advantages.

F. A. M. offers the following remarks on the advantages of making failures.

"No! I am not going to say it teaches patience and perseverance, though that is true; there is another reason why it is really better to fail at first than if we should happen to succeed at the first attempt.

"Everyone admits that we learn more by our failures than by our successes; and yet we are all naturally anxious to succeed. It is certainly very discouraging to fail, yet failure is the road to success; every time you find out that a method or plan will *not* do, you are nearer towards the discovery of what *will* do. All those happy individuals whose easy manipulation of plane or chisel, brush or file, you so much envy, had to pass along the same path of disappointment and failure which has so nearly made you throw away your tools in disgust. Take courage then and have a little more British pluck, remembering that every failure should teach you something and bring you nearer to success.

"Suppose, for instance, you are learning to turn. You take up 'a piece of wood'; it happens to be seasoned, and you finish a more or less successful row of beads with only here and there a spiral mark across one of them; you keep that piece of work and *it does not split.* That was only so by chance, you never looked to see whether the wood was seasoned, and you have been confirmed in your carelessness by your success. If, however, you had picked up a piece of green wood, and, after exercising your skill upon it, you had found it a month afterwards, split from one end to the other, you might indeed have been disappointed, but you would have learnt by the failure, and would probably have become, by its means, a better workman, than if, as in the first case, you had succeeded by chance.

"When we fail, then, let us find out why it was, that we may avoid that source of failure another time; and then every failure will help us forwards to success."

Holtzapffel's Work on Turning, etc.

Amateur (*Hobart, Tasmania*).—This most admirable standard work will consist, when complete, of six volumes, of which five are now published. The subjects and prices of these five are as follows:

Vol. I. Materials, etc. 15s.
Vol. II. Cutting Tools, etc. 20s.
Vol. III. Grinding and Polishing. 15s.
Vol. IV. Hand Turning. 22s.
Vol. V. Eccentric Turning, etc. 30s.
Vol. VI. (Not yet published) will treat on Amateur Engineering.

I may say to your correspondent that I know of no books to equal these; and, that tho' he is a beginner, and perhaps *because* he is a beginner he should, by all means, obtain them: for, although they are so complete, they begin at the very beginning, and explain with such clearness that one might well succeed with no other tutor. I advise Amateur to begin with Vol. IV., and then he can obtain the others if he wishes to persevere with the occupation. Since he writes from Tasmania, and as I have been there, I may congratulate him on the excellent native wood at his disposal; native pear-tree and "she-oak" pleased me very much.—F. A. M.

The Woodbury Tissue.

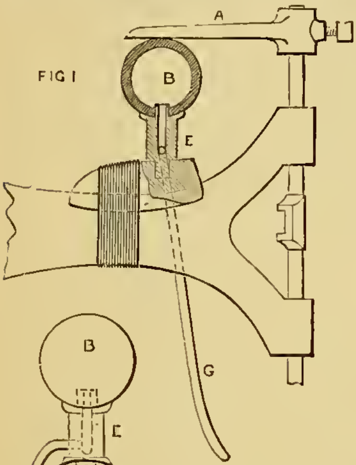
Subscriber from Commencement sends the following:—"I write to express my great appreciation of the way in which you supply *most valuable* information of all sorts. At the present moment I wish to thank you and Mr. Joseph Harris, for his paper on the 'Woodbury Tissue' and 'Dark Slide.' I have been an Amateur photographer for more than 25 years, and think I have now nearly arrived at perfection as regards taking negatives (I wish I could say the same as to Positive printing). Immediately on reading Mr. Harris's article I wrote to the Woodbury Tissue Co., and have received the very greatest civility from their manager. I have used the tissue and dark backs with the *greatest* success, and am delighted with them, and I strongly advise all amateur photographers to try them. I may say that though a constant reader of the 'Photographic News,' I never heard of the tissue until I learned about it in your valuable paper."

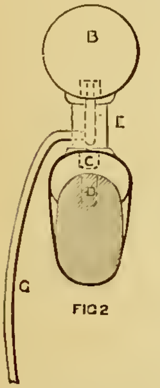
Cement for Fixing Lamps.

H. A. H. (*Manitoba*) writes:—"For fixing the burners of petroleum—or, as they call them here—'coal oil lamps,' to the glass oil receptacle, I have found ordinary alum melted in an iron spoon and then ponred round the metal cup, excelleut. This forms a clear crystalline cement very strong and durable. It is a 'tip' I learnt from a Canadian. Plaster of Paris is not good."

Blower for Fretsaw.

AMATEUR (*Hobart, Tasmania*).—The easiest plan for a beginner would, I think, be to obtain an indiarubber ball about 2 inches in diameter, and about ¼ inch thick (it *must* be thick). Then turn a piece of hard wood like E (Figs. 1 and 2), and fit tbe ball on to it. Now you should, if possible,



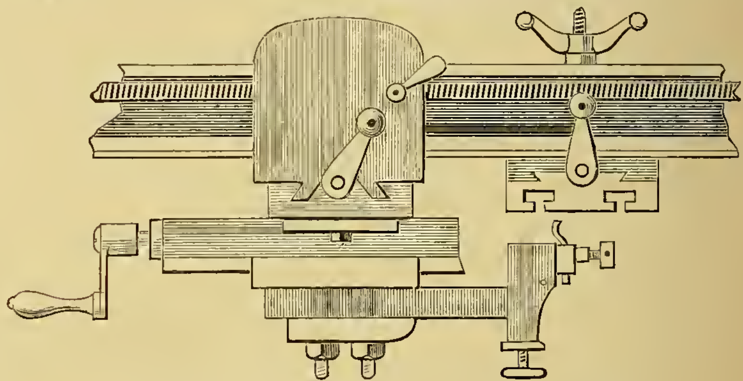


BLOWER FOR FRET-SAW.
Fig. 1.—Blower (in Section) with Attachment.
Fig. 2.—Blower attached to Support (in Section).

bore a hole D into the arm of fret-saw and turn peg C to fit; bnt as this is just what would be likely to tronble you, I have shown in the sketches a little wooden saddle fixed on to the arm by binding wire, and the hole is bored into this saddle; if you paint saddle aud wire it will not look so very bad. A is an adjustable arm and G a bit of pewter or compo pipe.

Turbine Motor.

TRUE BLUE.—To take your questions in the reverse order. 5th. Yon can never get more work ont of a machine than is put into it. Do you not see that if your turbine is working you require all its power for your work. If you make the turbine throw back into the cistern any of the water which has gone through it, yon would be wasting your power, as the turbine would only throw back about one-twentieth of the water it would nse, as there is friction to take into account. You seem to be looking after perpetual motion. 4th. The higher the fall tbe greater the power. There are turbines which work with a fall of two feet and others a hundred fect. If you can construct your tank on tho top of your house you would have ample power—of course ten feet would do, but you would want a larger turbine and a larger supply pipe. 3rd. You would have to consult the Tables found in "Manuals of Hydraulic Engineering" for this, it depends on the height of the supply. I think a two-inch iron pipe would do you comfortably; you must remember the ram could be working all day aud storing up water for the night, which is, I presume, the time yon are working. 2nd. For two-horse turbine, about two or three inches. 1st. The cost of such a small turbine I could not tell you, but look at the advertisements and write to makers of turbines for price list. I think it would be better for you to get one of the Thirlmere, or percussiou, class of motors. Look in the advertisement colnmns of the "English Mechanic."



MODIFICATION OF SLIDE-REST FOR PLANING AND SHAPING.

Modification of Slide-Rest for Planing and Shaping.

A. F. C. (*Bombay*) writes:—"Perhaps one of the writers in 'Amateurs in Council' (*e.g.*, OLLA PODRIDA, to whom I and others owe many a pleasantly-spent honr), will criticise the accompanying diagram showing a mode in which the slide-rest of a screw-cntting lathe may, it seems to me, be used for the purpose of planing and sbaping. The metal to be planed would be bolted to the slotted platform, and the cutter traversed by means of the leading screw with the rest. Even Lee's planing attachment costs something considerable; and an adaptation of the kind I suggest wonld, I think, serve all the requirements of ordinary amateurs."

Washing Machine.

JOB II.—The macbine represented by woodcnt forwarded by you is very nsefnl for small clothes or white things, but you wonld scarcely be satisfied with it for general purposes, which include heavy articles. The revolving apparatus is objectionable in that it does not wash the dirt out of "corners," and also that it is heavy to work. The best principle is that which has a reciprocating and squeezing motion. There is a machine ou this principle made by, I believe, a Glasgow firm, of the name of Craig. It is an excellent affair, covering a wide range of work, from stockings to blankets. For the latter class of work it is thorough, and beats "tramping" bollow. This matter has been constantly before me, but the difficulty is to steer clear of patented forms, and to hit on a serviceable machine, the principle of which would be clear of infringement.—OLLA PODRIDA.

Ornamenting Bed-Plate of Model Engine.

MODEL ENGINE.—You might try the "Chez Lni," mentioned in tbese pages a few months since. You may probably get your bed-plate done for you by one of the Coventry tricycle or sewing machine firms. Tbe work to which you refer is, I believe, stoved.—J. P.

Electric Gas Lighter.

J. H. S. (*East Dulwich*).—An illustrated article on "Automatic and Electric Gas Lighters" will be taken in hand at once, and appear in AMATEUR WORK as early as circumstances will allow.—G. E.

Castings for Field Magnets.

BARKING ROAD.—The rough castings for the field magnets of dynamos and electric motors of a small size, cost from 3s. to 5s. a set, and can be obtained from Messrs. H. and E. J. Dale, 4, *Little Britain, London, E.C.*, Messrs. King, Mendham, and Co., *Fairfax Street, Bristol*, or any other dealer iu electrical sundries. If you will write to Mr. Jones, whose address was recently given in these columns, stating the size of armature reqnired by yon, he will doubtless send you a price list.—G. E.

Best Saws for Metal and Iron.

G. M. H. (*Blackheath*).—If you want a good "hack saw" for metal, go to any of the dealers in tools, such as Messrs. Churcbill and Co., R. Melhuish and Sons, and otbers, wbose names have been mentioned in this magazine as supplying goods of this class.

Pure Mercury for Barometer.

J. H. S. (*East Dulwich*).—This can be procured from any chemist at a cost of about 4s. per pound. One fluid ounce of mercury will weigh a little over 14½ ounces, avoirdupois. Measure the capacity of the tube or cistern, and calculate the weight required. —G. E.

Fret Saw for Lathe.

G. M. H. (*Blackheath*).—I cannot undertake, nor can OLLA PODRIDA, to tell you which of the lathe fret-saws already described in this magazine, would suit you best. You must, having the entire work in your possession, consider them all, and make your choice. Possibly the "Fret Sawing Machine Adapted for Small Lathe," described by OLLA PODRIDA himself, in Vol. IV., page 571 (Part 47), would suit your purpose as well as any.

Mushroom Growing.

G. M. H. (*Blackheath*).—For full particulars for growing mushrooms you may consult Beeton's "New Book of Garden Management." I cannot attempt to give "full particulars" in these pages.

Metal Stand for Camera.

LEX.—I have never made a tripod stand from brass tubing, so cannot give directions how to make one. *This*, again, I think you will be hardly able to manage. Pumphrey's Patent Pocket Tripod is the best metal stand made. The price is £1; it may be obtained from the patentee, Mr. A. Pumphrey, 2, *Stanhope Street, Birmingham*, or from any of the dealers.—C. C. V.

Silvering Clock Dials.

J. H. S. (*East Dulwich*).—You will find information on this subject in the first article on "Electro-Plating at Ho[illegible] in Vol. I. —G. E.

Boot Repairing.

G. M. H. (*Blackheath*).—Mr. Abel Earnshaw is no longer on the staff of this magazine. It is not possible to give fuller instructions for making and mending, sewing and riveting, than you will find in his papers. It is not possible for me to tell you the cheapest place in London for buying leather for patching, but I will counsel you to bear in mind that the cheaper the leather, the less likely it is to be good. The best leather always commands a good price. For tools and materials used in Boot and Shoe Making you might try Mr. Elworthy, 3, *Shoe Lane, Fleet Street, London, E.C.*

INFORMATION SUPPLIED.

Glasses for Fretwork Epergne.

MR. A. GEBHARDT LAKER writes:—"If EPERGNE (page 432) has not been informed where he can obtain glasses for his piece of work, I believe he can get them from Messrs. Bailey and Co., Cosmopolitan Glass Works, 40, *Mortimer Street, Cavendish Square, London, W.* I obtained a set at that place when in town, for a gentleman who had made up the epergne, and who was residing in Scotland. As I designed the Supplement, I feel it my duty to give any advice in my power."

Paper for Mounting Photographs.

C. C. V. replies to ONLY AN AMATEUR:—From the description you give, I think the paper you require is what is known as "Flock" paper. It is used extensively for cut-out mounts, lining show-cases, and other purposes. It is *supposed* to be an imitation of velvet, and is manufactured in various colours, the most popular being maroon. Almost any mount-maker would sell you a small quantity, but it can be purchased from Messrs. Brown, Scott, and Co., *Red Lion Yard*, 254, *High Holborn, London, W.C.*, 19 inches wide, in rolls of 9 yards, and 22 inches wide in 12 yard lengths, the prices being 5s. and 7s. 6d. respectively.

Hammock-Making.

MR. EDWINSON writes in reply to W. A. (*Liverpool*):—"An illustrated article on 'How to Make Canvas and Netted Hammocks' is now in course of preparation."

Model Gun.

STADT DRESDEN writes in reply to A READER FROM THE FIRST:—"Cannot you go to Woolwich Arsenal, and get a look at the guns? You will be unable to make a scale model, because sufficient dimensions are not published. You do not say if you want to make a muzzle loader or a breech loader. It will be difficult to make a breech loader only 5 inches long, and in either case, the size is too small to allow of much detail, 10 inches or 12 inches would be better. The dimensions of the 101 ton muzzle loaders are: length, 31½ feet; diameter of breech coil, 6¼ feet; bore, 20 inches. I do not know any dimensions of the breech

FIG 1

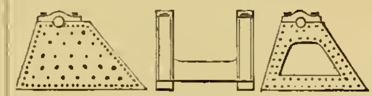


FIG 2 FIG 4 FIG 3

101 TON MUZZLE-LOADING GUN.

Fig. 1.—Shape of Model 101 Ton Muzzle-Loading Gun; the parts 1, 2, 3, 4 increase in size ½ inch. Figs. 2, 3.—Different forms of Carriage. Fig. 4.—End view of Carriage.

loader. The two forms of carriage, both of which are composed of iron plates riveted together and stayed. The carriage runs on a slide. I append sketches of the shape of gun and carriage."

Metronome.

BOD writes:—"As no one seems to have been able to help FARIDA (page 384), I beg to send the following, which is written with an instrument before me, which I made from an article which appeared many years ago in, I think, 'The Boys' Own Paper.' Make a bob of lead the size of half-crown, and to weigh 5 ozs., bore a hole from edge to edge about $\frac{1}{16}$ inch diameter. Take a piece of tough wood 13¾ inches long, and somewhat less than ⅜ inch square, and pare it thin, except about 2 inches at one end, pare 1¼ inch at the thick end to fit the hole in the bob, bore a small hole through the thick part 1⅝ inch from the bottom of the bob, through which put tightly 4 inches or 5 inches of knitting needle. Take a piece of tin 2¾ inches by 1¼ inches, and cut two slits the longer way. Slightly bend it so as to slide it on the thin end of the pendulum. Draw a line across the pendulum at 12¾ inches from the lower part of the bob, and mark it 20, put the edge of the bottom slit to this mark, and it will indicate twenty beats a minute. Mark the rest of the pendulum by lines ⅝ inch distance from each other, and they will indicate a difference of ten beats a minute; thus 12⅛ inches will give thirty; 11½ inches will give forty, etc. This may vary somewhat, according to the weight of the materials used, but it can be corrected by actually counting the beats in a minute. Put the instrument on the top of a glass tumbler, so that the needle rests on the edges of the glass, and it is ready for use. This does not give sounds, but if it is placed before the player, he will be able to note its indications and read his music at the same time."

Maelzel's Bell Metronome.

TWIST DRILL writes:—"In reply to MAD JACK, I beg to enclose a rough drawing of the mechanism of the bell metronome (which, by-the-by, is not a musical instrument, as his query appears to show). A, in Fig 1, is the beating wheel, which actuates the pendulum G, regulated by the sliding bob H; I, K are the pallets. The bell is worked by any one of a number of wheels

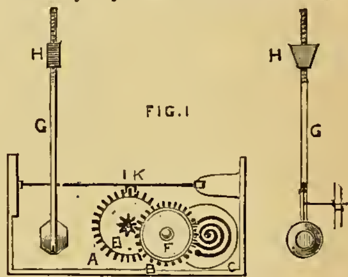
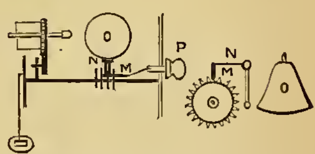


FIG 2



MAELZEL'S BELL METRONOME.

Fig. 1.—Beating Portion of Mechanism. Fig. 2.—Striking Mechanism.

on the same axle as A, into any one of which the hook M, Fig. 2, on the crank of the hammer, N, can be geared by moving the handle P."

Shoemaker's Wax.

ST. CRISPIN writes:—"In reference to the query by J. L. D. (*New Quay*), I will put him in the way of making a much superior wax for shoemaking purposes than those hitherto supplied to him in AMATEUR WORK, and which has been proved by myself and a host of other sons of St. Crispin; in fact, I got the method from one of our oldest and, I may add, best bootmakers in London. The ingredients to be used are: 1lb. of resin, 4 ozs. of good pitch and 1 oz. beeswax. Break into small pieces and put into an iron pan, and hang it over the fire to be melted slowly; when thoroughly melted, add sufficient sperm oil or pure tallow to make the wax the softness required. In cold weather it will require more grease, in hot weather less. Then proceed as previously advised by MAD JACK, etc., in page 432 of this volume."

Hydraulic Ram.

STADT DRESDEN writes in reply to T. B.: —"I would recommend you to buy one, as to make one would cost about half as much again, unless you are going to make a dozen or so. You do not state how many gallons per minute you require."

Clockwork Movement for Models.

STADT DRESDEN writes in reply to LAP: —"R. A. Lee, *76a, High Holborn*, makes what you require. His work is thoroughly to be depended upon. I do not know his prices."

Removal of Glaze from Emery Wheel.

STADT DRESDEN writes in reply to ROVER: —"You can remove the glaze by running the wheel wet. If you have nothing to grind, hold a bit of sandstone against it."

INFORMATION SOUGHT.

Naxos Union Company.

F. A. E. (*Bailieboro'*), and G. M. H. (*Blackheath*), wish for the address of the Naxos Union Company, who, according to answer in "Amateurs in Council," page 479, have emery wheels for sale. [When correspondents mention any trading company or firm, or any person who keeps any particular class of goods for sale, it is desirable that the address of the company, firm, or person, should be added.—ED.]

Steel.

G. M. H. (*Blackheath*) writes to know the cost per lb. of all kinds and sizes, and the cheapest place to get it in London. [A reply to the latter part of this question will be practically sufficient for the writer's purpose. The "cheapest place" being pointed out, he can obtain prices there on application.—ED.]

Bagpipes.

J. W. S. (*Orkney*) asks:—Can any correspondent of AMATEUR WORK give me any information on making a stand of Highland Bagpipes, especially the different lengths and sizes of bore of drones? And where to get drone and chanter reeds, and a list of the different kinds of wood employed? Also, where I might get a chanter complete, ready to fix to bag, will much oblige.

Sale of Fretwork.

FRET-SAW wants to know if there is any place that first-class fretwork could be regularly disposed of to advantage.

Magnifying Glasses for Penholders, &c.

J. L. D. (*New Quay*), writes:—"I should like to know of any firm in England or on the Continent that are selling those glasses which are fixed in penholders, pincases, etc. I mean those glasses that have designs on them, which magnify by looking through a hole, to a very large size. I should like to procure them in dozens or gross, to be fixed by myself."

Magazines, Second Hand.

J. L. D. (*New Quay*), asks:—Are there any second-hand book shops at which magazines such as the "Boy's Own Paper," etc., are sold cheap? [Try Mr. Joseph Plattnauer, *Fetter Lane, London, E.C.*, who buys up old magazines for enabling those who wish to complete sets to do so. His general charge is half the published price. —ED.]

Pantograph.

W. B. H. (*Blandford*), writes:—"The sketch of a Pantograph in AMATEUR WORK, page 382, by H. P. A., differs from one which appeared in "The Queen," Dec. 9, 1876, page 418, by the extension of the two middle bars from H and G to D and E, instead of terminating them at the hinges H and O. I should like to know the advantage, if any, gained by the addition, as I made mine from the description given in 'The Queen,' and it seems to answer very well."

Old Violin and Bow.

OAKLEIGH writes:—"Will Mr. Heron-Allen kindly give me the following information. Some three or four years ago I bought a violin from a friend of mine, he had had it in use for more than 20 years. The only history I can get of it is as follows: the gentleman I bought it of, Mr. Haddock, of Leeds (professional violinist), who bought it of some one in Manchester, where it was used a great many years as leading instrument at some of the concerts held there. It is *supposed* to be an old 'Duke.' There is not a ticket inside, the back is in one piece, and the varnish is in excellent condition, of a pale golden colour. The wood of the back, neck, and scroll is beautifully marked. How or where can I get to know who the maker of the violin was? In looking over your interesting articles, and from your illustrations of sound holes, the nearest description is the Amati. I have also an old 'Dodd' bow, with ivory nut and screw end, beautifully light and perfect, what is the value do you think?" [If I send your queries to Mr. Heron-Allen, I can by no means be certain of getting a reply from him, so I insert your communication in the hope that some reader who is interested in violins may be able to answer them. I think, myself, that the surest way for you to obtain the information you require is to take the violin and bow to Mr. W. E. Hill, *Wardour Street, Soho, London, W.*, and ask him to examine them.—ED.]

Entrance of Rain through French Windows.

OAKLEIGH writes:—"In my house I have French windows, opening inwards, and I find a difficulty in keeping out the rain when it beats in a certain direction, and there are weather boards on all the windows." [Write again, and give a transverse section of the valves of your window so that its construction may be perfectly clear. It is difficult to advise without having more precise information than is given above.—ED.]

Mounting Stag's Horns.

OAKLEIGH asks: — Will some of our readers inform me how to mount a pair of stag's horns, and polish them, they are just as I got them from the park?

Boiler Lamp.

STADT DRESDEN writes:—"I observe an omission in my query respecting Boiler Lamp, in page 432, which alters the meaning entirely. The eighth line of query should read, 'Size of boilers, 16 inches by 8 inches by 6 inches, *each composed of* 8 tubes ½ inch internal diameter, $\frac{1}{16}$ *inch* apart.' The words in italics are those missing. To be more explicit, the boilers are composed of tubes bent thus ≷, but with the corners rounded. I know the design of the 'Shipman Engine,' but as I cannot leave the Fatherland, I am unable to see it." [The omission is due to yourself, and not to the printers or to me. There was an omission above, between "$\frac{1}{16}$" and "apart" which I have supplied. The word in italics is that missing. As you *know* the design of the Shipman Engine, you may not require to see it, although I am inclined to think that a close inspection of the engine itself and its action would be of much service to you. —ED.]

Book on Ornamental Glass Blowing.

GODRESJEE, writing from *Bombay*, asks: — Can any reader of AMATEUR WORK guide me to some good text book on ornamental glass blowing?

Lacquered Brass Screws.

R. A. W. (*Dublin*) asks:—"Can anyone tell me where I can get lacquered brass screws, plain and bronze colour, also nickel plated? Nearly all the brass fittings sold are lacquered, but the screws are not, so that in a very short time the heads appear as black spots on the bright brass. I think manufacturers should give their attention to this matter. [Could you not overcome the difficulty by applying lacquer of the colour required to the heads of the screws? —ED.]

Telegraphic Sounder Instrument.

W. A. (*Liverpool*) asks:—Will any reader of AMATEUR WORK give me instructions how to make a telegraphic sounder instrument such as is used in the Post Office? and also name the best battery to work it with."

Removal of Glaze from Emery Wheel.

W. A. (*Torquay*) asks: — How is a glazed emery wheel to be cleaned? Is the glazing a consequence of want of speed? [See reply by STADT DRESDEN to ROVER on mode of cleaning wheel, given in the first column of this page.—ED.]

Clog Sole.

J. G. wishes for a description of a clog sole, how it is made, name and price of machinery required to make it, where the machinery can be had; also if the machinery could be worked by hand power.

Cabinet for Bric-a-Brac.

CLYDE writes:—"I would feel much obliged if any of your readers could furnish me with a simple effective design for a cabinet to contain bric-a-brac. One to stand on a table, or on a stand, say about 3 ft. by 2 ft. by 1½ ft. would be suitable. Something with a little turned work could be managed." [I have in hand a very effective and easily-constructed cabinet, supplied by L. S. D. (*Jamaica*), which, I think, will meet your purpose, though there is no turned work in it, and which will appear as soon as I can make room for it.—ED.]

LETTERS RECEIVED UP TO SEPT. 8.

[*Replies to these in Next Part.*]

INDISSOLVABLE; J. L. D. (*New Quay*); T. R. (*Pickering*); PRACTICAL WATCHMAKER; J. G. (*Ballyhannis*); W. L. (*Golborne*); TAURUS; CORKEY; A. W. H. (*King's Lynn*); C. A. P.; JACK; ROSEWATER; Prof. L. MARISSIAUX; C. W. N. (*Southgate*).

GENERAL SYNOPTICAL INDEX.

ANALYTICAL INDEX TO "AMATEURS IN COUNCIL."

☞ *When an Asterisk* (*) *follows the Pagination, it denotes that the Article to which reference is made is Illustrated.*